THE POSITIVE BACKGROUND
OF
HINDU SOCIOLOGY

VOL. XVI Sacred Books of the Hindus

BOOK I.—NON-POLITICAL.

BY

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WITH APPENDICES

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TO THE MEMORY OF

THE LATE ANTIQUARIAN AND ART-CRITIC,

DR. RAJENDRALALA MITRA,

THE FIRST INDIAN SCHOLAR, AND THE FATHER OF THE NATIONAL SCHOOL OF INDIAN HISTORICAL RESEARCH

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DR. UDAY CHAND DUTT,

THE PIONEER OF INVESTIGATIONS REGARDING THE CHEMICO-MEDICAL AND MEDICO-BOTANICAL ACHIEVEMENTS OF THE HINDUS;

AND

TO THE DISTINGUISHED SAVANT,

DR. BRAJENDRANATH SEAL,

A LIVING ENCYCLOPÆDIA OF MODERN SCIENCES AND ORIENTAL *Vidya*, THE APOSTLE OF HINDU CULTURE, AND INSPIRER OF YOUNG INDIA IN PHILOSOPHICO-COMPARATIVE STUDIES

THIS SMALL TRIBUTE OF SINCERE APPRECIATION AND GENUINE REGARD

IS MOST RESPECTFULLY

DEDICATED

BY THEIR HUMBLE ADMIRER,

THE AUTHOR.

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FOREWORD.

The present volume is a part of '*The Positive Background of Hindu Sociology*' which is meant to be the Introduction to my English translation of the Sanskrit work on Sociology entitled *Sukraniti*, published as Volume XIII of the 'Sacred Books of the Hindus' Series. "The Positive Background" will be divided into two books: (1) Non-Political and (2) Political.

Besides the six chapters presented in this volume, Book I (Non-Political) will comprise:—

Chapter VII.—The Data of ancient Indian Art (Architecture, Sculpture and Painting).

Chapter VIII.—The Data of ancient Indian morals and manners (including socio-religious rites and institutions).

Chapter IX.—The Data of ancient Indian Pedagogy (including *vidyâs*, kalâs, and literature).

Chapter X.—The Data of ancient Indian Economics (including Statistics of Prices, Wages, &c.).

Book II (Political) will comprise the following:—

Chapter I.—The Data of ancient Indian Polity or Constitution, *i.e.*, form of Government (including the Theory of the *Râṣtra* or State).

Chapter II.—The Data of ancient Indian Public Finance.

Chapter III.—The Data of ancient Indian Jurisprudence.

Chapter IV.—The Data of ancient Indian International Law (the Doctrine of *mandala* as influencing the conceptions regarding 'spheres of influence' and 'spheres of interest').

The work is based mainly on an analytical study of Sukrâcharyya's code, so that the Data of Hindu Sociology collected here reflect strictly those phases of Indian national evolution which have influenced the authors of the Sukra cycle. This 'Positive Background,' therefore, is more or less a *statical* picture, and represents only such landmarks in the culture-history of the Hindus as are embodied in the single document *Sukraniti*. It must not be regarded as the result of any attempt to delineate the *dynamical* processes of the historic growth of Hindu civilisation or represent the several stages in the making of modern Indian life and thought. Recent works of this class are Principal Iyengar's *Life in Ancient India in the Age of Mantras*, and Mr. Narendranath Law's *Studies* in *Ancient Hindu Polity* (based on the *Arthasâstra* of Kauṭilya).

There are, however, a few historical sections and sub-sections in the 'Positive Background." These should not, on the one hand, be looked upon as

recording the characteristics of the various cultural landmarks of Indian history; nor, on the other, be regarded as wholly superfluous digressions uncalled for in the *Introduction to Sukranîti.*

These historical sections have been necessary for two reasons. In the first place, the Code of Sukrâchâryya as well as the Data of Hindu life portrayed in it could not be presented in their proper perspective and their date as well as *locale* could not be ascertained unless Indian literature were studied chronologically as well as comparatively. In this respect the author feels that he has not been able to rise to the height of the occasion; for, as has been often stated with regret in the body of the book, he has had to ignore not only the Tâmil, Prâkrit, and vernacular evidences, but he has not even been able to utilise the more important documents of Sanskrit literature, not to speak of the unpublished manuscripts, telegraphic descriptions of which are to be found in Prof. Aufrecht's *Catalogus Catalogorum.*

In the second place, for a proper appreciation of the Hindu achievements in science, abstract or applied, it is indispensable to have always before one's mind's eye the landmarks in the history of western science. Much of the prevalent notions regarding the alleged inferiority of the Hindu genius in grappling with the problems of this mundane sphere and the extra-proneness of the Indian mind to metaphysical and unpractical speculations can vanish and be proved to be the results of mal-observation and non-observation leading "to half-truths which are really whole errors,"—only if we apply the Historico-Comparative method in studying Indian facts and phenomena. For all Indologists should remember that the wonderful achievements of the western nations are strictly speaking only a century old. So that if, while instituting a comparison between Hindu and Occidental cultures on the score of physical 'sciences' properly so-called and applied arts and industries, care were taken to eliminate from one's consideration the triumphs and discoveries of the last few generations, the Hindu scientific intellect would be found to have been in no way lagging behind. The sole corrective of false notions about Hindu civilisation is this "sense of historic perspective," which for the present generation of Indian scholars should be tantamount to a thorough familiarity with the history of European thought.

This brings me to an explanation of the title of the work. The *Introduction to Sukraniti* has been called 'The Positive Background of Hindu Sociology,' because Sukranîti as a *Nitisâstra, Arthasâstra, Dharmasâstra,* or *Dharmasutra* deals mainly with the topics implied by such Hindu categories as *Dharma* (morals), *Artha* (interests,) and *Kâma* (desires and passions) as opposed to *Mokṣa* or Salvation; and hence a study in Sukranîti should properly be a study in the non-*mokṣa* or non-transcendental and non-spiritual, *i.e.*, the secular, worldly and 'positive' elements of Hindu social economy.

The transcendental and other-worldly aspects of Hindu life and thought have been made too much of. It has been supposed, proved and believed during the last century that Hindu civilisation is essentially non-industrial, and

non-political, if not pre-industrial and pre-political, and that its sole feature is ultra-asceticism and over-religiosity which delight in condemning the 'World, the Flesh and the Devil'!

Nothing can be farther from the truth. The Hindu has no doubt always placed the transcendental in the foreground of his life's scheme, but the Positive Background he has never forgotten or ignored. Rather it is in and through the positive, the secular, and the material that the transcendental, the spiritual and the metaphysical have been allowed to display themselves in Indian culture-history. The *Upaniṣads*, the *Vedânta*, and the *Gitâ* were not the works of imbeciles and weaklings brought up in an asylum of incapables and a hospital of incurables.

The Hindu has never been a 'scorner of the ground' but always 'true to the kindred points of heaven and home,' has been solicitous to enjoy the good things of this earthly earth and beautify this 'orb of green.' The literature, fine arts, religious consciousness, industrial life, political organisation, educational system, social economy, etc., of the Hindus—all have sought to realise this synthesis and harmony between the eternal antitheses and polarities of the universe: the worldly and other-worldly, the positive and transcendental, the many and the one, the Form and Spirit, Culture and Faith, Science and Religion, Caste disunions and Vedantic Oneness, Image-worship and the realisation of the Infinite (*Brahma*).

In the newly-published *Sâdhanâ*[1] of Rabindranath Tagore we have a collection of prose-lyrics, half-poetic and half-philosophic, dealing with this synthesis of world's eternal opposites or dualities. The papers on the *Problem of Evil, Realisation in Love, Realisation in Action, Realisation of Beauty*, in this volume of metaphysical essays in 'poet's prose' bring out the Hindu ideal of harmony between the Finite and the Infinite, Bondage and Freedom, Necessity or Law and Joy. "The Immortal being manifests himself in joy-form" (आनन्द रूपममृत ण्द्विभाति). "The joy which is without form, must create, must translate itself into forms." (P. 104.) It is this ideal, again, that is at once the inspiration and message of most of Tagore's Poetry, which thus carries forward the transcendentalised positivism of the makers of Hindu civilisation through the ages "along fresh fields and pastures new" of modern Bengali thought. The philosophy of reconciliation between the so-called Evil and Good, the Form and Spirit, Caste and Vedanta, Image and the Infinite has thus uttered itself in mystical Bengali verse:

भाव पेते चाय रूपेर् माझारे अंग,
रूप पेते चाय भावेर माझारे छाडा।
असीम से चाहे सीमार निविड संग
सीमा हते चाय असीमेर माझे हारा॥"

This ideal of realising the Infinite in the Finite, the transcendental in the positive, manifested itself also in the educational system of Hindu India.

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[1] Macmillan & Co.

The following is reproduced from my Bengali essay read at a Bengal Literary Conference about two years and a half ago translated subsequently for the 'Collegian' as *Pedagogy of the Hindus* :

"Was that system essentially monastic and ascetic, and did it kill all secular and social instincts of the learners? Did the *Brahmachâris* come out from the preceptors' homes merely as monks, missionaries and *sanyâsis?* Could they not satisfy the diverse material wants of man? Did they not know how to provide for the necessaries, comforts and decencies of life? Was the education absolutely non-political? Did not the students learn how to help in the administration of the state? Were not social and political sciences, plant-life and dissection of animals, physical phenomena and chemical manipulations among the courses of instruction? * * *

"How else can we account for the remarkable progress of the nation in architecture, sculpture, medicine, dyeing, weaving, shipping, navigation, military tactics and implements and all such aspects of socio-economic and economico-political life as have to depend on the help of physical and natural sciences? * * * The graduates trained up under the "Domestic System" were competent enough to found and administer states, undertake industrial and commercial enterprises; they were builders of empires and organisers of business concerns. It was because of this all-round and manly culture that the people of India could organise vast schemes of colonisation and conquest, and not content with being simply confined within the limits of mother India, could build up a Greater India beyond the seas, and spread culture, religion and humanity among the subject races. * * *

"It was under the influence of this system of education, again, that the ideal Hindu king "protected himself, but not through fear; followed the dictates of religion, but not through remorse; realised revenues, but not through greed, and enjoyed happiness, but not through attachment * * * That system certainly cannot be dismissed as inexpansive, inert and unfit to survive that could produce Risis from Vasistha and Viswâmitra to Râm Prasâda and Râmkrisna Paramhamsa, scholars from Charaka, Pânini and Chânakya to Chandra Kânta Tarkâlankâra—a race of eminent women from Maitreyi to Ahalyâ Bâi and Râni Bhavâni, monarchs from Chandragupta Maurya to Sivâji, and has continuously kept up the genial stream of national culture and civilisation through diverse forms and agencies by giving rise to hosts of thinkers and actors capable of solving different problems in different ages."

It is because the secular achievements of Hindu civilisation have not been accorded by scholars the attention they deserve, and a proper estimate of the Positive Background of Hindu socio-economic and socio-political life has not been framed, that the distorted picture of a race of metaphysicians, airy philosophers, and transcendental speculators has been drawn regarding Indian people to excite the pity of the go-ahead pushing occident and pander to the foolish, unthinking vanity of the present day fallen orient. The *Upanisads*, the *Vedânta*,

the *Bhakti Sâstras*, the *Darsanas*, the *Gitâ*, and the whole body of Hindu transcendental literature in which people may find the 'solace of their life' as well as the 'solace of their death,' cannot, however, be fully appreciated and interpreted in the true light until and unless we bring to bear upon them the results of investigations regarding the social, economic, political, international and other human institutions and ideals, in the midst of which this literature has flourished and that have actually governed the life and activity of the Hindus. This mass of metaphysical lore requires, in fact, to be regarded as the " criticism," as Matthew Arnold would say, of Indian " life " and its problems and achievements. The transcendental speculation has to be understood and explained with reference to the *milieu* and environment according to the philosophico-comparative methods followed in the Schools of Literary Studies founded by such critics as Taine, Edmond Scherer, Sainte Beuve and Dowden. This should really be looked upon not as the sole but only as *one* of the various features in the organic growth and historic evolution of Indian literature, institutions, civics, arts and industries.

The principal correctives of the one-sided, partial and erroneous view about Hindu life and ideals, in addition to what we have already stated, are thus two :—(1) a more searching and detailed inquiry into the economic, political and art history of India, and (2) a study, according to the canons of scientific literary criticism, of the whole literature of Hindusthan, Sanskritic, and Dravidian, Prakrit and vernacular, in both its metaphysical and secular branches.

So far as the secular branches of Sanskrit literature are concerned, it would not be too much to remark that the adequate parallax for modifying and correcting the false notions about Hindu genius can be supplied if the *Kâvyas, Nâtyas, Kathâs, Purâṇas, Tantras, Itihâsas, Vâstuvidyâs, Silpasâstras, Arthasâstras, Nitisâstras, Dharma-sutras* and *Smritis* were critically investigated as documents of Indian historico-sociological development. These alone cannot fail to impress upon the inquirer to what great extent the eternal verities of the universe and the highest problems of life enunciated and discussed in the *Darsanas, Upaniṣads, Gitâ*, &c , have influenced and governed the ordinary pursuits of human life in India, and embodied in its thousand and one rites, usages, institutions and festivals; to what enormous proportions the transcendental culture-lore of the Hindus has been humanised, secularised, and popularised by being translated and adapted into the common-place folk-lore—to what depth the Hindu ideal of realising the one in the many, the Infinite in the Finite, the Ideal in the Real, the Transcendental in the Positive, has been done into the actual life and work of the people. It will be evident to every close student of this literature that the synthesis of world's permanent polarities has been concretely demonstrated and manifested in the ever-moving gradations of the social polity known as *Varṇâsrama*, the Hymeneal rites and marriage rules, the Joint Family, the Cottage Industry, the autonomous system of co-operative village commonwealths, the *Âchâryyakulas*, the *Pariṣats*, the elastic theological apparatus and religious paraphernalia, the institution of

kingship, and the doctrine of *mandala* or sphere of international activity that constitute the complex web of Indian life.

To take only one instance—the *Raghuvamsam* of Kālidāsa, the immortal epic of Hindu India. It is impossible to study it from cover to cover without noticing how powerfully the greatest poet of Hindusthan has sought to depict this Hindu ideal of synthesis and harmony between the positive and the transcendental, the भोग (Enjoyment) and the त्याग (Renunciation). *Raghuvamsam* is the embodiment of Hindu India in the same sense that *Paradise Lost* is the embodiment of Puritan England. The grand ambitions of the Vikramādityan era, its colossal energies, its thorough mastery over the things of this world, its all-round economic prosperity and brilliant political position, its Alexandrian sweep, its proud and stately outlook, its vigorous and robust taste are all graphically painted in this national epic, together with the "devotion to something afar from the sphere of our sorrow," 'the light that never was on sea or land,' the *sanyāsa, vairāgya, ahimsā, yoga,* preparation for the other world, the idea of nothingness of this world and the desire for *mukti* or perpetual freedom from bondage.

This antithesis, polarity or duality has not, however, been revealed to us as a hotchpotch of hurly-burly and pell-mell conflicts and struggles, but presented in a serene, sober and well-adjusted system of harmony and synthesis which gives the "World, the Flesh and the Devil" their due, which recognises the importance and dignity of the secular, the worldly and the positive, and which establishes the transcendental, *not to the exclusion of,* but only above as well as in and through the civic, social, and economic achievements.

The greatest example of the Hindu ideal of synthesis, and hence of world's highest ideal, is to be found in the picture where Kālidāsa beggars his hero, the Indian Napoleon, the conqueror of the four quarters, at the end of his proud *digvijaya* and 'triumph' by making him perform the *viśwajit* sacrifice, which necessitates the giving away of the whole of his earthly belongings (मृत्पात्र शेषा मकरेद विभूतिं) Truly, the greatest artist of Hindusthan has sung of the Synthetic Ideal of the One in the Many, the Infinite in the Finite, the Transcendental in the Positive (ज्ञाने मौनं क्षमा शक्तौ त्यागे श्लाघाविपर्ययः) as the sole motto of the House of Raghu

"सोऽहमाजन्मशुद्धानामाफलोदयकर्म्मणाम् ।
आसमुद्रक्षितीशानामानाकरथवर्त्मनाम् ॥
यथाविधिहुताग्नीनां यथाकामार्चितार्थिनाम् ।
यथापराधदण्डानां यथाकालप्रबोधिनाम् ॥
त्यागाय सम्भृतार्थानां सत्याय मितभाषिणाम् ।
यशसे विजिगीषूणां प्रजायै गृहमेधिनाम् ॥
शैशवेऽभ्यस्तविद्यानां यौवने विषयैषिणाम् ।
वार्द्धक्ये मुनिवृत्तीनां योगेनान्ते तनुत्यजाम् ॥
रघूणामन्वयं वक्ष्ये..."

The same Vikramâdityân grasp of this mundane sphere, the same vigour in attacking the problems of secular life, the same human, practical and positive outlook, the same solicitude for the discharge of the 'lowliest duties' that characterise the heroes of Kâlidâsa whose natural ambition was no meaner than that of swaying not only the lithosphere from sea to sea, but also the atmosphere and the skies (आसमुद्रक्षितीशानामानाक रथवर्त्मनां), confront us at every step throughout the Smriti, Niti, Artha, Śilpa and Vâstu Literature. The Lectures of Professor Sukra, the Doctor of Social Philosophy and Legislation, to his disciples, the Asuras and Daityas, constitute one of the most important documents of this literature; and, as such, socio-economically and economico-politically illustrate the Kâlidâsic ideal of harmony between the positive and the transcendental or realisation of the transcendental in and through the positive.

Strictly speaking, the position of *Sukraniti* in this literature is unique and unparalleled. It is, in the first place, a manual of guidance to kings and statesmen, as well as the Bible of the demos—at once the work of a Machiavelli and a Rousseau. In the second place, it is a handbook of economics, politics, ethics, and what not.

Yâjnavalkya Smriti will ever command reverence as a text-book of Jurisprudence, *Manu Samhitâ*, because of the sanctity and age associated with the name of Manu, the first law-giver. So also the *Arthaśâstra* of Kautilya, the Finance Minister of Chandragupta Maurya, the first Empire-builder in Hindusthan, must ever be looked up to by the historian as a contemporary Statute-Book or Imperial Gazetteer of India in one of the first epochs of her political consciousness, and as the handiwork of one of the world's most powerful statesmen of historic authenticity. But all these venerable documents of Hindu Positive literature cannot compare in comprehensiveness and encyclopædic character with the *Nitiśâstra* of the Professors of the Śukra cycle in the form in which we have it to-day. And comparatively modern though *Śukraniti* is, it is inevitable that *Kâmandaki Niti*, the abridgment of Kautilya's masterpiece, should pale into insignificance before it. For the whole culture of Hindu India, its methodology and its achievements have been really compressed into *Śukraniti* and have contributed to its making. For the moderners it is of inestimable value as "lifting the brain-cap" of mediæval India and letting them "see the thoughts" that were moving in her educated mind. As a text-book of Sociology, the *Nitiśâstra* of Sukrâchâryya is thus the Spencerian "Synthetic philosophy" of Sanskrit literature.

The study of *Sukraniti* is for all these reasons really a study of Hindu Positivism, the human, secular and worldly elements in Hindu national life and culture, the place of earthly things, *Samsâra, Vâsanâ, Bhoga*, desires, passions and attachments in the Hindu scheme of human existence—in short, a study of the positive background and foundations of Hindu Sociology, as opposed to its transcendental foreground and superstructure.

This work is humbly dedicated to three great masters of modern India who may be looked upon as pioneers in the study of the secular achievements of

Hindu culture. The celebrated archæologist and historian, Dr. Râjendralâl Mitra, is undoubtedly the first Indian 'scholar.' And yet the comprehensive grasp, erudition and industry which mark the researches embodied in his *Indo-Aryans*, *Antiquities of Orissa* and other writings in Journals, remain probably unsurpassed even now. It is to Dr. Mitra, the father of the National School of Indology and Indian historical scholarship, that every student of the positive branches of Hindu civilisation must begin by paying homage.

The scholar who, likewise, first brought to light the contributions of the Hindus in physical science is Dr. Udaychând Dutt. It is his researches in Hindu medicine, chemistry, and botany, that have paved the way for subsequent workers in the same field. And the monographs of Dr. Brajendranâth Seal (by securing whose services as King George V. Professor of Philosophy the Calcutta University has only honoured itself) on the *Physical, Chemical, and Mechanical Theories of the Hindus* as well as their "*Scientific Methodology*" (published along with Dr. Roy's *History of Hindu Chemistry*), have done more than any other work to establish philosophically the claims of Hindus as having contributed to world's scientific concepts, categories, and discoveries. It has been the special mission of Dr. Seal to demonstrate by the historico-comparative method that the Hindu explorers of the physical universe were not mere empirics who, by stretches of brilliant imagination or sage-like intuition, unconsciously hit upon some of the mysteries of Nature. Nor were they merely craftsmen, alchemists, industrialists, &c., engaged in practical agriculture and manufacture without any knowledge of the general principles and theories, but real scientists, researchers and investigators, who knew how to manipulate the machinery and logic of 'exact' science and patiently awaited the results of their observation and experiment.

Thus, as Dr. Seal remarks :—" Let us not superciliously dismiss these studies as 'learned lumber.' The astronomy and mathematics were not less advanced than those of Tycho Brahe, Cardan, and Fermat, the anatomy was equal to that of Vesalius, the Hindu logic and methodology were more advanced than that of Ramus and equal on the whole to Bacon's ; the physico-chemical theories as to combustion, heat, chemical affinity, clearer, more rational and more original than those of Van Helmont or Stahl, and the Grammar, whether of Sanskrit or Prakrit, the most scientific and comprehensive in the world before Bopp, Risk and Grimm." (Quoted by Dr. P. C. Roy in the Preface to the Second Edition of *Hindu Chemistry*, Vol. I).

There are many scholars from whose writings or discussions with whom I have derived direct or indirect help and suggestions. I should specially mention Mr. Haridâsa Pâlit, Research Scholar, District Council of National Education, Malda, Prof. Râdhâkamal Mookerji, M. A., Krishnath College, Berhampore (Bengal), Kumâr Narendra Nâth Law, M.A., B.L., Research Scholar and author, Calcutta, Rai Bahadur Sarat Chandra Dâs, C.I.E., Tibetan traveller and Chinese scholar (Darjeeling), Major B. D. Basu, I.M.S. (Retired), versatile scholar and linguist and learned editor of the 'Sacred Books of the Hindus Series,' Mr.

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I have to acknowledge also my deep debt of gratitude to Dr. Seal for his kindly allowing me to incorporate with this work a few chapters of his learned monographs on the physical sciences and scientific notions of the Hindus. It is superfluous to add that his papers on Hindu ideas about plants and plant-life, Hindu classification of animals, Hindu ideas about Nervous System, Heredity, Vital Force, &c., Hindu Mechanics and Hindu Acoustics, which are being first published through the medium of this work, have considerably added to its value and importance. The humble author begs to add that this has been the only means of rescuing precious treasures from the ravages of time and moths, which, thanks to the habits of the learned Doctor, have been often allowed to work havoc upon what would have been epoch-making studies in ancient Hindu culture that have thus been lost to the world for good.

Books quoted from or summarised for this work have been mentioned in the footnotes, as well as tabulated in the Bibliography. It may not, however, be out of place to state that several vernacular works and periodicals have been largely drawn upon, and that the following works have been of constant service: Prof. Aufrecht's *Catalogus Catalogorum*, Dr. Mitra's *Indo-Aryans*, Dr. Ray's *Hindu Chemistry*, Ram Raz's *Essay on the Architecture of the Hindus*, Vincent Smith's *Fine Art in India and Ceylon*, Sir Bhandarkar's *Peep into the Early History of India*, the Sanskrit Ms. *Yuktikalpataru*, Iyer's *Brihat Saṃhitâ*, Mookerji's *Indian Shipping* and Krishnaswamy Aiyangar's *Ancient India*, of which the chapter devoted to Chola history and administration must be of more than ordinary interest to students of early mediæval Indian life.

The libraries to which I am indebted are the National Council of Education Library at Calcutta, the Public Library at Allahabad and the Library of the Pâṇini Office which is specially rich in works on Indian antiquities, Sanskrit literature and modern science.

Finally, it remains to add that portions of this work were published as Magazine articles in the *Modern Review* (Calcutta), *Indian Review* (Madras), *Collegian* (Calcutta), *Hindusthan Review* (Allahabad), *Dacca Review* (Dacca), *Amrita Bâzâr Patrikâ* (Calcutta) and *Leader* (Allahabad).

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Whitney and Lanman ...	Atharva-Veda (Harvard Oriental Series, Vols. 8 and 9, 1905).
Williams, Monier	Hinduism.
Wilson, Professor ...	Vishnu Purâṇa, (London, Trübner & Co., 1868).

N.B.—The Text of *Sukraniti* translated and used for this work is that edited by Dr. Gustav Oppert for Madras Government in 1882. And the references are always to *lines*, not to slokas. Thus Sukra. IV, ii, 131, indicates l. 131 of section ii of chapter iv.

17 MAR 1912

THE POSITIVE BACK-GROUND OF HINDU SOCIOLOGY.

BOOK I.—NON-POLITICAL.

CHAPTER I.

RELATIVITY OF THE NÎTISÂSTRAS.

SECTION I.

Hindu Culture and Sociology in Sûkraniti.

The Greek philosopher Plato was for some time tutor to a king of Syracuse in Sicily. Machiavelli, the Florentine diplomat, who has bequeathed his name to a school of politicians, was the author of a work that proved to be the Bible of kings and princes in mediæval Italy and Europe. The '*School-master*' of Roger Ascham was written for the princesses of an English royal family. The sage Sukrâchâryya, or at any rate, his *nom de plume,* belongs to the same gallery of world's *Râjgurus* or royal tutors. And his *Nitisâstra* or 'Treatise on Morals' is dogmatically asserted to be the sole authoritative[1] text-book on Political Science that should be used by Hindu kings and statesmen. This opinion of Sukrâchâryya about the position of *Nitisâstra* has been referred to by Kâmandaka also (II. 5): "According to the school of Usânas (Sukra) there is only one division of learning, namely *Dandaniti,* and the origin of all kinds of learning lies in this one." It would, therefore, be interesting to find out for which Hindu Court or Courts this manual was intended, or which supplied data for the rules and generalisations embodied in it.

The scope of a Nîtisâstra is more or less like that of a Dharma-sutra or Dharma-sâstra, one of the three divisions of Kalpa-sutra, which is one of the Six Vedângas or auxiliaries to Vedas. The province and relative position of Dharma-sutra in Sanskrit literature are thus described by Oldenberg:[2]

[1] Chaptor IV, Section vii. 851-6.

[2] Introduction to the *Grihyasutras* of Gobhila, Hiranyakesin etc. in the *Sacred Books of the East Series* xxxiii—iv.

"The frame within which the exposition of the Dharma-sutras is enclosed is an essentially broader one than in the case of the Grihya Sutras.* * The same phenomenon may also be observed in Buddhist Vinaya literature, where the exposition of the life of the community was at first given only in connection with the explanation of the list of sins (Pàtimokkha).* * It was not till later that a more comprehensive exposition, touching all the sides of the life of the community was attempted.* * The Grihyasutras begin to treat of the events of the daily life of the household,* * confine themselves principally to the ritual or sacrificial side of household life, as is natural owing to their connexion with the older ritualistic literature (Srauta Sutra). Then the Dharma-sutras take an important step further; their purpose is to describe the whole of the rites and customs which prevail in private, civil and public life. They naturally among other things touch upon the ceremonies treated in the Grihyasutras, but they generally merely mention them and discuss the question of law and custom which are connected with them, without undertaking to go into the technical ordinances as to the way in which these ceremonies are to be performed."

It may be doubted at the outset if the class of writings called Dharmasâstras, Arthasâstras, and Nîtisâstras to which *Sukranîti* belongs were (1) the work of a single individual or school, and (2) were ever the Gazetteers designed to embody the actual state of things, or Statute-Books meant for the guidance of the people and rulers of any particular epoch or region. It may be presumed that like Plato's *Republic* and *Laws*, Moore's *Utopia*, and Harrington's *Oceana*, *Sukranîti* is the product of the same inspiration that has lain at the bottom of all efforts to portray the ideal constitution of 'nowhere', describing things 'that never were on sea or land' in the history of world's speculative literature. Thus about *Manu Samhitâ*, Elphinstone remarks: "We must remember that a code is never the work of a single age, some of the earliest and rudest laws being preserved and incorporated with the improvements of the most enlightened times.** Even if the whole code referred to one period it would not show the real state of manners. Its injunctions are drawn from the model to which it is wished to raise the community, and its prohibitions from the worst state of crime which it was possible to apprehend.* * * Though early adopted as an unquestionable authority for the law, I should scarcely venture to regard it as a code drawn up for the regulation of a particular state under the sanction of a government. It seems rather to be the work of a learned man, designed to set forth his idea of a perfect commonwealth under Hindu institutions."[1]

According to this view it may be inappropriate to trace the production of *Sukranîti* to, the patronage or influence of any of the numerous polities and royal courts in Hindu India. But even the most idealistic literature is not absolutely independent of age and clime. The Time-Spirit and Place-Spirit are too powerful to be totally ignored by human genius even if it consciously

[1] *History of India*, p. 12 (1880).

attempt it. The social environment and physical surroundings—both the aspects of the great envelope of man—cannot but leave their marks upon his intellectual consciousness and literary activities of any considerable magnitude. Leaving aside for the present, therefore, the most vexed of all questions in Indian history, the determination of the personality, identity and individuality of our author, we propose to investigate all the social and physical influences that are likely to have contributed to the making of *Sukraniti*, as available from a study of the data furnished by it. This investigation is really a study of the education received by our author himself, and of the literature drawn upon by him in the preparation of his work, in one word, a presentation of the whole culture embodied in, and pre-supposed by, *Sukraniti*. A study of this culture, and the "relativity" of *Sukraniti* to this envelope of physical and social-forces and influences, would, however, incidentally furnish some of the evidences pointing to the age and locale of the work.

The relativity of *Sukraniti* to the social influences may be easily presumed like that of *Manu Samhitâ*, as has been done by Elphinstone: "It is evident that it incorporates the existing laws, and any alterations it may have introduced with a view to bring them up to its pre-conceived standard of perfection, must still have been drawn from the opinions which prevailed when it was written." So also the influence of physical and geographical factors on the work, and consequently its "relativity" to a particular region of the earth's surface cannot be missed.

SECTION 2.

Land-marks in the History of Hindu Political Development.

Even superficial students of *Sukraniti* do not fail to perceive that the Executive system, Judiciary, Military administration as well as other incidents of social, economic and political life described in it indicate a high degree of development, and are adapted not to simple village-republics and tribal commonwealths or city-states that we meet with in certain periods of Indian and European history, but are the outcome of the complex requirements of 'country'-states or Imperial organisations.

Now Ancient and Mediæval History of India furnishes the following more important types of political life that have evolved in connexion with the magnificent kingdoms or empires of the Hindus :—

1. The Maurya Empire of Chandragupta and Asoka (4th and 3rd centuries B.C.) embracing modern Afghanistan, the whole of Upper India, and Southern India, excluding the extreme south (Chola, Pândya, Kerala, Satyaputra and Ceylon).

2. The Gupta Empire (4th century A. D.) which was brought to an end by the incursions of the Huns.

3. The Empire of Harsavardhana (7th century A.D.) in Upper India during the latter part of whose reign Houen Thsang, the great master of Law from China, travelled in India.

4. The Empire of the Châlukyas and Râshtrakutas in the Deccan[1] (fifth to fourteenth century A. D.)

5. The Empire of the Cholas in Southern India beyond the Deccan (ninth to fourteenth century A.D.).

Says Mr. Vincent Smith in his Introduction to Mr. Aiyangar's '*Ancient India*:'

"The Chola dynasty was singularly prolific in kings of more than ordinary capacity, from the middle of the ninth century to the end of the reign of Kolutunga in A. D. 1118. It is clear from the details on record that the administration of the kingdom was 'highly systematised' from an early date. For instance, there is abundant evidence that the lands under cultivation were carefully surveyed and holdings registered at least a century before the famous Domesday record of William the Conqueror. The re-survey of 1086 was exactly contemporaneous with the English record.

The Cholas were great builders; builders not only of cities and temples but also of irrigation works."

According to Mr. Aiyangar in *Ancient India*, "this is the period of high water-mark of Hindu progress all round. Modern Hinduism assumes the shape in which we find it to-day. The indigenous literature as well as classical Sanskrit receive considerable patronage. Religion has been re-adjusted to the requirements of the masses, and administration had come to be highly organised upon surprisingly modern lines. Revivalism in religion and re-invigoration were the order of the day." The story of one of the greatest monarchs of this period, Râjendra Chola (1013—1042), the son of Râjarâja the great, who, according to the inscriptions, carried his arms successfully across Kalingam, subdued Dakkana Lâtam, Vangaladesam, and the territory of Dharmapâla, fought battles on the Ganges and in Burma, and earned the proud surname of Gangâikonda Chola, has been preserved in the Kanarese work, *Râja Sekhara Vilâsam.* At the commencement of the 13th century the great Chola Empire was dismembered between the Yâdavas of Deogiri, Kâkâtiyas of Orangal, Hoysâlas of Dwârsamudra and other petty chieftains.

6. The Empire of the Pâlas and their successors at Gauda in Bengal (8th to 12th centuries A. D.)[2] synchronous with the ascendancy of the Châlukyas in the Deccan and the Cholas in the South.

"The period embraced by the long reigns of Dharmapâla and of his son Devapâla covers nearly a century, including the period spent in consolidating the district of Bengal by Gopâla after his *election* by the people." This was a period of the greatest activity of the Bengali people in various departments, as will appear from the monumental relics discovered and collected by the Vârendra Research Society. This period has another importance, as we know from the book of Lâmâ Târânâtha, that during these long reigns of Dharmapâla

[1] For an account of the Pallava, Chola, Châlukya, Râshtrakuta and other kingdoms in South India, see Aiyangar's *Ancient India*, pp. 31-38, 158—191.

[2] For an account of the hegemony of the Pâlas in Northern India as successors of Harsavardhana to Imperial titles and pretensions see the Bengali publications of the Vârendra Research Society of Râjshâhi, and Mr. R. D. Banerji's *Memoirs of the Pâlas* (Asiatic Society of Bengal.)

and of his son Devapâla, "an eastern school of sculpture and painting was established by Dhimâna born in Varendra, and by his son Vitapâla. * * * The reputed minister enabled his master Dharmapâla originally a lord only of the Eastern quarter, to extend his dominions to all the quarters, * * * over all the territories between the Himâlayas on the north and Vindhya mountains on the south between the two seas * * * The Lord of Gauḍa (probably Devapâla [1]) suppressed the Utkalas, humbled the Hunas, and crushed the pride of the Lords of Drâvida[2] and Gurjara."

It may be observed, in passing, that these recent researches of Indian scholars in the mediæval history of Eastern and Southern India from archæological, linguistic, commercial and other standpoints have unearthed important facts of Bengali and Tamil antiquities which prominently demand recognition in the standard works on Indian culture-history. The Pâlas and Cholas of mediæval India can no longer be treated as subordinate or petty princes ruling over the "Smaller kingdoms" in one of the so-called periods of disintegration which Indian history is said to repeat after every epoch of consolidation; but must be ranked as by no means inferior, in prestige, titles, pretensions, influences, and achievements, to the famous Vardhanas of the 7th cent. A.D., the Guptas of the 4th-5th cent. A.D. and the Mauryas of the 4th-3rd cent. B.C. Dharmapâla (c 800 A.D.) the Buddhist Emperor of Eastern India, with his immediate predecessors and successors, as well as Râjendra Chola, the great Śaiva monarch of the South, with his predecessors and successors, constitute two remarkable contemporary Imperial families which must have a place by the side of such renowned Indian Napoleons, Empire-builders, and statesmen as Chandragupta Maurya, Asoka, the benevolent "Cæsaro-papist," Chandragupta the Gupta, Samudragupta the Vikramâditya, and Harsavardhana, who preceded them in solving the same problems of administration, commerce, religion and culture on the stage of Hindusthan. The Drama of Indian History should, therefore, have its first Act closed not at the end of the 7th century with the passing away of the Vardhanas from Kanauj and Upper India, but really at the end of the 12th century (1193) with the overthrow of the successors of Pâlas in Eastern India by a lieutenant of Muhammad Ghori, and at the beginning of the 14th century (1310) with the overthrow of the successors of Cholas by a lieutenant of Alauddin Khilji.

The Hindu Period of Indian history does not end with Harsavardhana (7th cent.) and the subjugation by Mussalmans of certain Râjput States in

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[1] See the reading of the *Garuḍâ stambha* inscription interpreted by Maitra in '*The Stones of Varendra*' in the Modern Review for August, 1912.

[2] An important historical puzzle that awaits final solution is the relation between the Cholas and Pâlas in the 10th century. South Indian tradition points to the overthrow of the Bengalis by the Tamil Napoleon, East Indian tradition points quite otherwise. The Varendra School evidently accepts the overthrow of the Dravidians by the Pâlas, as here and also in Chanda's work, *Gauḍa Râjamâlâ*; South Indian scholars, however, accept the overthrow of the Pâlas and Vangalas as a historical fact (cf. Aiyangar's *Ancient India*). Prof. Mookerji records the Tamil View on pp. 174—177 of his *Indian Shipping*. See also R. D. Banerji's *Memoirs of the Pâlas of Bengal*, G. No. I (Asiatic Society of Bengal).

Western India in the 10th and 11th centuries.[1] For the social expansion, religious assimilation, commercial progress, and Imperial achievements which we are wont to associate with the brightest eras of Hindu national history were going on in Eastern and Southern Hindusthan, unhampered as of yore, along the natural lines of progressive evolution up till the 13th and 14th centuries, while the buffer-princes of Lahore, Delhi, Ajmere, Kanauj, Malwa and Gujrat were performing their duties as by position the gate-keepers of India against the inroads of aggressive Islam.

The period of the mighty Pâlas and Cholas and their successors has witnessed the solution of problems which are of paramount importance in Indian history, literature, fine arts, philosophy, and religion. For it was during this age that the ocean of Tantraism finally swallowed up in a common philosophy the divergent channels of Mahâyâna Buddhism and latter-day Brahmanism; that Vaisnavism and Śaivaism—the corner-stones of modern Hindu life-received the official stamp; the parents of present-day vernaculars were encouraged and 'protected'; noble religious edifices were built, huge sealike tanks were excavated; magnificent images were sculptured in bronze and stones; the navigation of the sea was pushed forward, commercial and cultural intercourse between the Southerners and Easterners was promoted; and India became really the School of Asia by supplying faith, literature, fine arts and material necessaries to China, Nepal, Tibet, Japan, Java, Burma and other lands beyond the seas. This period does, in fact, carry forward and develop the impulses, aspirations and tendencies of Hindu national life testified to by the Chinese Master of Law in Harsavardhana's time.

The Pâlas and Cholas are really the spiritual successors of the great Empire-builder and statesman of the 7th century. The epoch of their hegemony in Indian history is a brilliant sequel to the splendid epoch of Imperialism, religious toleration, maritime activity, and social amalgamation which it had been the policy of the great Harsa to pioneer and direct. Their services to the making of Indian national culture deserve the same meed of homage, therefore, from future historians as those of Sri Harsa.

And now that excavations, explorations, reading and interpretation of old vernacular manuscripts, copper-plate inscriptions, architectural monuments, numismatics, study of folklore, folk-songs, folk-arts and village traditions, Sanskrit literature, old sculptures and paintings, call up before us a picture of political and religious life, commercial and social intercourse, art-development, and literary progress no less definite and clear than what we have for any other period of Indian history, the necessity, of looking upon the Pâla-Chola period[2] as the really last phase of Hindu India cannot be too strongly advocated.

7. The Kingdoms of the Rajputs which beginning in the 9th or 10th centuries have continued their existence even now.

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[1] See Vincent Smith's *Early History* (second edition, pp. 330-331).

[2] Another oft-neglected period of Indian history—one of the so-called epochs of dissolution and decentralisation is the Andhra-Kushan age of Hindu national life.

8. The Kingdom of Kashmir which was ruled by Hindu kings till about the middle of the fourteenth century.

9. The Kingdom of Vijayanagara, called the 'Forgotten Empire' of the South in Mussalman times, the only important seat of Hindu culture in Mediæval India (14th—16th century A.D.).

10. The Empire of Mahârâstra under the Peshwas (18th century A.D.) whose administrative system has been elaborately described by the late Mr. Justice Ranade in his *Rise of the Maratha Power.*

These larger and more celebrated kingdoms and empires of the Hindus have flourished through over two thousand years of recorded history and in conditions of physical environment as varied as possible in a country like India, the 'epitome of the world.' The types of political organisation, therefore, that Indian history presents must be more or less diversified in character to meet the requirements of peoples living under diverse geographical and topographical influences. And one naturally expects a diversity of political codes or *Nitisâstras* or manuals of governmental rules. Inspite of the oneness and basic uniformity of Hindu life throughout India, the text-book of political life evolved in the extreme north, say Kashmir, is not likely to be that exactly adjusted to the needs of the Dravidians of the extreme south. Or again the rules and regulations which the Marathas framed for themselves in the west of India towards the close of the Mussalman period could not be copied *in toto* from a chapter of the *Nitiṣâstra* that was taught, say, to the Pâla Kings of Bengal in pre-Mussalman times. Politics like everything else of human life are the results of adaptation to the circumstances of time and place; and the history of a people has ever been powerfully influenced by the geography and topography of its habitat.

An analysis of the geographical facts and phenomena occurring in the Hindu *Nitisâstras* or treatises on morals (social, economic and political) is therefore likely to be an important factor in assigning each to the proper sets of physical and social conditions under which it was composed.

SECTION 3.

Mile-stones in the History of Hindu Political Speculation.

(*a*) *Arthasâstra.*

There is no difficulty about the *Arthasâstra* of Chāṇakya or Kautilya, the Minister of Chandragupta Maurya who for the first[1] time in Indian history conceived and executed the plan of a vast Empire, the limits of which it has not been possible for any monarch to reach or exceed.

Like Abul Fazl's *Ayeen Akbari*, the *Arthasâstra* may be looked upon as the *Imperial Gazetteer of India* in one of the most remarkable periods of

[1] In the *Fundamental Unity of India* (Longmans Green & Co.) Prof. Mookerji traces the Hindu conception of Imperialism and paramount Sovereignty from Vedic times (*vide* Chapters XIX—XXIX).

Indian culture-history. The chapters of this monumental document are devoted exclusively to a description of the multifarious incidents of political life under Chandragupta's government, *e.g.* the working of the mines, the opening of irrigation works, the establishment of factories ; the maintenance of preserves and grazing grounds, of high ways of commerce, waterways, land-routes, and other facilities for communication ; the establishment of markets and stores ; the construction of embankments, dams and bridges ; the planting of fruit and flower trees, of medicinal plants and herbs (*i.e.* the establishment of Ayurvedic and pharmaceutical gardens) ; protection of the disabled, the helpless and the infirm, and also of beasts &c., famines, census, central and municipal government, livestock and many other social, juristic and economic institutions.

In the Introduction to Mr. Law's *Hindu Polity*[1] Prof. Radhakumud Mookerji of the National Council of Education, Bengal, has summarised the "arguments which may be advanced in support of the traditional and widely current view that the Arthasâstra of Kautilya is the work of Chânakya the minister of Chandragupta and therefore belongs to the 4th century B.C." The writer has proved from both external and internal evidences—

(1) That the political connexion of Kautilya with Chandragupta as his Finance Minister is a fact and not a myth.

(2) That the *Arthasâstra* attributed to Kautilya is a genuine work of antiquity and not a traditionally handed down fable.

(3) That the work is the production of an individual author and not of a school, as is frequently the case with Indian treatises.

(*b*) *Kâmandaki Niti.*

The work of Kâmandaka[2] is undoubtedly an abridged edition of *Artha Sâstra*, and the author himself is supposed to have been the disciple of Kautilya. A flood of light is thrown on the age and personality of the author of *Kâmandaki Niti* from a report submitted by Dr. Frederick to the Batavian Society of Arts and Sciences on the Sanskrit literature of Bali. "It appears that the most popular work on Polity in that Island is entitled *Kâmandakiya Niti Sâra.*[2] The researches of Sir Stamford Raffles and Crawford shew that the predominance of Buddhism in the Island of Java obliged the Hindu inhabitants of that place to retire in the fourth century of the Christian era with their household gods and their sacred scriptures to the island of Bali. * * * It has also been shewn by the same authorities that since the period of their exile, they had not any religious intercourse with India. It would therefore follow that the Sanskrit works now available in Bali, including the *Kâmandakiya Niti* are of a date anterior to the 4th century A.D."

As a document of sociological information, this work is less valuable than *Sukraniti*. Its importance has, however, to be noticed because of the Chânakyân

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[1] Law's *Studies in Ancient Hindu Polity* (1914 Longmaus Green and Co., London).

[2] *Kâmandakiya Niti Sâra* published by Manmatha Nath Datta (Calcutta, 1896).

Doctrine of *Mandala* or "sphere of political activity and influences," which is not to be found in Sukra's work.

(c) *Other works.*

The difficulties with regard to the other extant (or published) treatises are immense, especially because we do not know of any other political fabric that has left its own Statute-Book. *Yuktikalpataru* and *Sukraniti* are the two exclusively socio-economic and socio-political treatises that we have come across up till now. Accounts of economic and political theories as well as practices are also to be met with in almost every branch of Sanskrit literature. Some of the *Purânas*, all the *Smritisâstras*, *Manusamhitâ*, *Mahâbhârata*, *Râmâyaṇa*, *Panchatantra*, *Raghuvanśa*, *Kirâtârjuniyam*, *Hitopadeśa*, *Daśa-kumâracharita*, together with treatises devoted to *Dhanur Veda* or Warfare and International Laws, notices of which are found in the celebrated *Catalogus Catalogorum of* Prof. Aufrecht, are especially rich in the subject-matter of *Nitisastras*.

Several such works are the following :—

Nîtiprakâśika, Harivanśa, Utpalaparimâlâ, Charaṇavyuha, Krisṇavidyâbhyâsa prakaraṇa, Sankalpasuryyodaya, Prasangaratnâvali by Mâdhavarâma, Kâmasûtra (Vâtsâyana), Vidura-nîti, Vaisampâyana Nîti, and Brihatsamhitâ.

There is, besides, a Nitisâstra attributed to one Ghatakarpara mentioned by Stein in Kashmir Catalogue (p. 93). In the statement of sources for his series of learned papers on Hindu Polity contributed to the *Modern Review* (1913), Mr. K. P. Jayaswal mentions *Niti-Vâkyâmrita*[1] and the Marathi work *Dâsa-bodha*[2], the Bible of Sivaji, and refers to several Buddhist and Jaina texts. Some allusions to ancient civics are to be found in the Jaina works, *Nandi Sutra*, and *Riṣi mandala Prakaraṇavritti* quoted by Prof. R. K. Mookerji in the Introduction to Law's *Hindu Polity*.

(d) *Smriti Sâstras.*

The names of Smriti Sastras are given from Vasu's *Yâjñavalkya Smriti*, Book I, Chapter I, Introduction 4-5 in the "Sacred Books of the Hindus Series."

"Manu, Atri, Viṣṇu, Hârita, Yâjñavalkya, Uśanas, Âṅgiras, Yama, Âpastamba, Samvarta, Kâtyâyana, Bṛihaspati.

Parâśara, Vyâsa, Śaṅkha, Likhita, Dakṣa, Gautama, Śâtâtapa, and Vasiṣtha are the promulgators of Dharma Śâstras."

The Mitâkṣarâ Commentary on the above is as follows :—

"This Dharma Śastra propounded by Yâjñyavalkya should also be studied, such is the implied meaning of the above passage.

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[1] *Cf.* Samadeva 1. Edited in the Kasyamata series.

[2] Mr. Jayaswal gives the English title of this work as "Address to the Enslaved." Really, it should be "The Awakening (or Enlightenment) of Râma Dâsa."

"This is not an exhaustive enumeration (*parisankhyâ*), but it is merely illustrative. Therefore, the Dharma Śâstras of Baudhâyana and others are not excluded.

"As each of these Smritis possesses authority, so the points not mentioned by one, may be supplied from the others.

"But if one set of Institutes contradicts the other, then there is an option (to follow any one of them)."[1]

Bâlambhaṭṭa's Gloss on the above furnishes much interesting information on the subject.

Devala gives the following list of the Dharma-Śâstras:—1. Manu, 2. Yama, 3. Vasiṣṭha. 4. Atri, 5. Dakṣa, 6. Viṣṇu, 7. Aṅgirâ, 8. Uśanâ, 9. Vâkpati, 10. Vyâsa; 11. Âpastamba, 12. Gautama, 13. Kâtyâyana, 14. Nârada, 15. Yâjñyavalkya, 16. Parâśara, 17. Samvarta, 18. Śaṅkha, 19. Hârîta, 20. Likhita.

In this list Nârada is an addition, while in the Yâjñyavalkya's list we have Sâtâtapa instead.

The Śaṅkha gives the following list:—1. Atri, 2. Brihaspati, 3. Uśanas, 4. Âpastamba, 5. Vasiṣṭha, 6. Kâtyâyana, 7. Parâśara, 8. Vyâsa, 9. Śaṅkha, 10. Likhita, 11. Samvarta, 12. Gautama, 13. Śâtâtapa, 14. Hârita, 15. Yâjñyavalkya, 16. Prachetas and the rest. By the phrase "and the rest" is meant 17. Budha, 18. Devala, 19. Sumantu, 20. Jamadagni, 21. Viśvâmitra, 22. Prajâpati, 23. Paiṭhînasi, 24. Pitâmaha, 25. Baudhâyana, 26. Chhâgaleya, 27. Jâbâla, 28. Chyavana, 29. Marîchi, 30. Kaśyapa.

In the Bhaviṣya Purâṇa we find the following addressed by Iśvara to Guha:— "Having pondered over the texts of the eighteen Purâṇas, O child, and over the texts of the Smritis, beginning with Manu and which are thirty-six in number, I now tell thee.'.

[This shows that the Smritis are 36 in number.] The Smritis like the 1. Vriddha-Śâtâtapa, 2. Yogi—Yâjñyavalkya, 3. Vriddha-Vasiṣṭha, 4. Vriddha-Manu, 5. Laghu-Hârita, &c., should be included in the well-known thirty-six under their original anthors. [Thus Manu includes the ordinary and the Vriddha Manu, and so on.] Thus Yâjñyavalkya says (III. 110) "I have declared the science of Yoga."

Ratnâkara says: "we find in the Bhaviṣya Purâṇa itself the enumeration of other Smritis like Gobhila, Riṣya Śringa, &c., which are over and above the thirty-six; so we conclude that thirty-six does not exhaust the number of Smritis, but is only an enumeration made by the Śiṣṭas." Those which are found as Grihya Sûtras and their Pariśiṣṭas, &c., they belong to a different Category: like the Purâṇas. As in the Bhaviṣya:—"The Maitrâyaṇîya, the Chhandogya, the Kaṭha, the Âpastamba, the Bhavrichas, their Pariśiṣṭas and those called Khilas (are also Smritis)."

The Viṣṇu-Dharma, the Śiva-Dharma, the Mahâbhârata, and the Râmâyaṇa and the rest are also to be included among Smritis. As says the Bhaviṣya:—"The eighteen Purâṇas, the history of Râma (Râmâyana), the Viṣṇu-Dharma-Sâstra, &c., the Śiva-Dharma; the fifth Veda called the Mahâbhârata composed by Kriṣṇa-Dvaipâyana, the Sauradharma, the Manavokta Dharma, are also taken as such by the wise," (adhyâya 4, v. 87-88).

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[1] See Manu, II, 14, for conflict of Śruti, &c.

"But when two sacred texts (Śruti) are conflicting both are held to be law; for both are pronounced by the wise to be valid law."

The words "as such" in the above mean that they are also followed by the great men, and are authoritative, because they are not decried or dispraised by any and followed by great men, so they are to be taken also as Smṛitis. The opinion that the Smṛitis are thirty-six only in number, or twenty-four only in number, is held only by some and is contradicted by others, and is not authoritative.

That the Smṛitis are Dharma-Śâstras (Institutes of Sacred Law) we learn from Manu II. 10, where it is said "The Vedas should be known as Śruti; and the Dharma-Śâstras as Smṛiti."

In Âṅgiras we find:—"The wise say that the following are Upa-Smṛitis:—Jâbâli, Nâchiketa, Chhandas, Laugâkṣi, Kaśyapa, Vyâsa, Sanat Kumâra, Śatadru, Janaka, Vyâghra, Kâtyâyana, Jâtukarnya, Kapiñjala, Baudhâyana, Kaṇâda, and Viśvâmitra."

In Hemâdri Dâna Khaṇḍa the following more are enumerated: "Vatsa, Pâras-kara, Pulastya, Pulaha, Kratu, Ṛiṣyaśriṅga, Âtreya, Babhru, Vyâghra, Satyavrata; Bharadvâja, Gârgya, Kârṣṇâjini, Laugâkṣi, and Brahma-Sambhava."

The Smṛitis of Prajâpati, Yama, Budha, and Devala which are enumerated in Kalpataru are quoted by Hemâdri as authority in the course of other authorities.

The Kalpataru holds that the four sciences mentioned in the Viṣṇu Purâṇa (III 6. 20) as they relate to positive physical sciences should be taken as authority and Dharma in matters worldly. Those sciences are "the Âyurveda (Medicine), the Dhanurveda (Archery), the Gândharvaveda (Music), and the Artha Śâstra (the science of wealth)—thus the sciences are altogether eighteen" (Viṣṇu Purâṇa, III. 2. 26).

So also in the Śaiva Purâṇa, the Vâyavîya Saṁhita, chapter one, it is said: "O Romaharṣaṇa! O all-knowing! thou hast obtained through good luck a complete knowledge of all the Purâṇas from Vyâsa. The four Vedas, the six Aṅgas, the Mîmâṁsâ, the Nyâya, the Purâṇa and the Dharma Śâstra are fourteen Vidyâs. The Âyurveda (medicine), the Dhanurveda (Archery), the Gândharvaveda (Music) and the Artha Śâstra (the science of wealth) are the additional four, making the Vidyâs eighteen. Of all these eighteen Vidyâs, treating of different topics, the original author and direct prophet is the Trident-handed Śiva: such is the saying." (Śiva Purâṇa, I. 23).

Though all these are sources of law, yet all of them do not deal with all matters; and sometimes they contradict each other. Therefore, the commentator says that, though each of them is an authority, yet the lacunæ of one should be supplied from the other, where one is incomplete; and where they differ there is option. Manu has also taught this option in II. 14: "But when two sacred texts (Srutis) are conflicting, both are held to be law; for both are pronounced by the wise to be valid law."

(e) *Traditional Abridgment of Nîti Sâśtras.*

The *Smriti Sâstras* have for their subject-matter a greater amount of socio-religious topics than are usually dealt with in *Nîti Sâstras.* Their authorship is, besides, attributed to Rishis, as we have seen in the previous enumeration. The Rishi upon whom our work has been fathered is mentioned in the above list as Uśanas. It is believed that Uśanas or Sukrâcharyya was the last of the Rishis who meddled in Polity; and that since his time the whole science of morals (social, economic and political) called *Nîti Sâṣtras* has been designated after him.

Sukrâchâryya himself records the history of the abridgment of *Niti Sâstras* towards the commencement of our work: "For the good of men Brahmâ had spoken that treatise on morals which contained 100 lakhs *i.e.*, 10 million slokas. By a process of selection the essence of that *Niti Sâstra*, which was an extensive argumentative thesis, has been compiled in an abridged form by Vasiṣṭha and others like myself for the increase of prosperity of rulers of the earth and of others whose life is of short span."

The same tradition[1] is otherwise stated thus: "Formerly for the protection of creatures Brahmâ wrote the science of Polity in ten million chapters. Siva obtained this from Brahmâ and epitomised it in ten thousand chapters. His work is called Vaisâlakṣya from his name (Visâlâkṣa or large-eyed). Indra made an abridgment of it in five thousand chapters, and Sukra into one thousand. Thus it was gradually abridged by the various sages having in view the shortened life of the people around them."

(*f*) *Yukti-Kalpataru.*

The association of gods and Rishis with the works on *Niti* and allied topics, and the tradition about their vast size and large number, as well as the custom of attributing works to one's *gurus* make the problem of a systematic treatment of Hindu political science all the more difficult. Equally puzzling is the association of works with historical characters, men of real flesh and blood, round whom, however, legends like those of Alexander and Charlemagne have grown up mystifying their age, locale as well as personality. One such work is the *Yukti Kalpataru*, giving "an account of all requirements in a royal court," as Professor Aufrecht observes. The work is still in manuscript, but was first noticed by Dr. Râjendralâl Mitra, and since his time, has been drawn upon by Indologists in their treatment of things Indian, specially secular matters. The work is attributed to King Bhoja (Vikramâditya?) of Dhâra in Malwa and has been described by the author as compiled from *nivandhas* or treatises of various *munis* or masters on the subjects. The following account of the work is being given from the manuscript (108 leaves), written in Bengali character, belonging to Mahâmahopâdhyâya Adityarâma Bhattâchârya, now in the possession of the Panini Office.[2]

The botanical name of the work has been explained at the beginning just after the salutation to Krishṇa, "the Parameswara, who by undoing the happiness of Kansa did really promote his happiness, who is worshipped by the gods and is really unadorable," and to the "makers of Sâstras whose words purify good men, even for the hearing." Just as a *Kalpavrikṣa* or the wishing-tree (like the wishing-cow) celebrated in Hindu religious lore yields the satisfaction of all desires, so "wise men by resorting to this *Kalpataru* (the treatise so called) can achieve the most longed-for objects." "The root of this tree is *Danda niti* (the science of

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[1] Dutt's *Kâmandakiya Niti Sâra.* (Calcutta, 1896.)

[2] The work is being edited by the present author.

punishment), the stem is *Jyotisha* (implying Astronomy, Astrology, Horoscopy and Mathematics according to the conception of the Hindus), the branches and flowers are the diverse *vidyâs* which deal with the facts observed (or the phenomenal world), the fruits are unknown and the *rasa* or sap is the nectar of the good, *i.e.*, promotes their welfare." "That *Kalpataru* should be respected by Kings and ministers, who should study their interests and deliberate on them according to its dictates as well as those of other sâstras." "This is most conducive to the welfare of Kings and promotes also the weal of others," (*i.e.*, people).

Thus the very definition of the term *Yukti Kalpataru* as the title of a book introduces the topics of a *Niti Sâstra* ; and, as a matter of fact, all the subjects dealt with in the work are the proper themes of works like *Sukraniti.* The following table of contents in the *Yukti Kalpataru* would indicate that the work is, like the *Artha Sâstra*, *Kâmandaki Niti*, *Sukraniti*, and *Ghatakarparaniti*, really a socio-economic and socio-political treatise, and is an additional document of Hindu secular literature in the department of Dharmasutras, Arthasâstras or Nīti Sâstras :

1. Nīti Sâstra. 2. Guru (Preceptor) and Purohita (Priest). 3. Amâtya (Land Revenue officer), Mantri (Foreign minister) and Duta (ambassador). 4. Lekhaka (scribe) and Jyotirjna (astronomer). 5. Purâdhyakṣa (Mayor or Superintendent of the city), Vanadhyakṣa (Superintendent of Parks and Forests). 6. Koshavardhaṇa (Development of Financial resources). 7. Râjadâyâda (sharers of the royal income). 8. Kriṣi Karma (agriculture). 9. Rathiṇ (charioteer), Sâdi (Horsemen or Cavalry). 10. Gajâroha (the art of elephant mounting, driving, etc.). 11. Yâna (Land and Water conveyances). 12. Yâtrâ (Expeditions). 13. Vigraha (warfare). 14. Chara (spy). 15. Dutalakshaṇa (Characteristics of ambassadors and spies). 16. Sândhi (Truce and Peace). 17. Âsana (Siege). 18. Dwaidha (Duplicity—a military technical term in Siege-craft). 19. Âśraya (seeking refuge or protection). 20. Dânḍa (Punishment). 21. Mantra (Policy or statecraft) 22-3. Dwandwa (Rivalry and Hostilities undertaken under two sets of circumstances, *e.g.*, i. *Akritrima*, *i.e.* conditions of natural fortifications, and ii. *Kritrima*, *i.e.*, conditions of artificial barriers and barricades, etc.) described with quotations from *Niti Sâstra*, Garga, and one Bhoja.

24. Pura-nirmâṇa (Building of cities). 25. Kâla (the auspicious time). 26. The *vasati* (an arrangement of various wards or quarters) described by quotations from Bhoja and Parâsara. 27. Doṣaguṇa (good and bad effects, according to Astrology). 28. Vâstu (Houses). 29. Dingnirṇaya (Directions). 30. Lakṣaṇa (style or characteristics of Buildings). 31. Mâna (Measurements). 32. Doṣaguṇa (good and bad effects). 32. Kâlanirṇaya (when to begin building new houses). 33. *Vâstu praveshakâla* (when to enter new houses). 34. Dwâranirṇaya (laying out of doors). 35. Prâchira (walls). 36-41. Vâstu-danḍa (various measurements of houses), Vinâsa griha, ranga, and Râjagriha (the twelve species of Buildings).

42. Âsanas (Thrones). 43. Khatikas (bedsteads). 44. Pitha (stools made of metals, stones or wood). 45. Chhatras (Umbrellas). 46. Dhwaja (Flags). 47. Châmara. 48. Chasaka (Drinking vessels). 49. Vastra (clothes). 50. Alankâra (ornaments).

51. Diamond. 52. Padmarâga (species of Emerald). 53-4. Examination, prices etc., of Diamonds. 55. Examination of Vidruma (corals). 56. Gomeda. 57-8. Pearls—their examination and prices. 59. Vaiduryya, Indranîla (Sapphire). 60. Chhâyâ (Transmitted Light). 61. Marakata (Emerald—its origin, and good and bad effects). 62. Pusparâga (Topaz). 63. Bhîṣmamaṇi. 64. Pulaka. 65. Sphatika (Quartz). 66. Ayaskânta. 67. Sankha (Conch).

68. Astra (Missile). 69. Khaḍga (Dagger). 70. Dhanu (bow). 71. Bâṇa (arrow). 72-3. Yâtrâ (Expedition)—the proper time for it. 74. Nirâjana (ceremony with horses and elephants).

75-9. Horses—Testing, their defects, how to strike them, etc. 80. Ritucharyya (seasons—and seasonal treatment of horses). 81-2. Elephants. 83-5. The Examination, Merits and Defects of Bulls. 86. Buffaloes. 87. Deer. 88. Dogs. 89. Goats. 90-3. Carriages of various kinds.

94. Naukâ Kâṣṭha (woods or timber for boats). 95. Boats of various kinds.

(g) *Hindu Râjneet in Ayeen Akbari.*

The political literature of the Hindus was known to Abul Fazl, who in the *Ayeen Akbari*,[1] has given a short synopsis of probably some of the *Nîti Sâstras* in his possession in the chapter on the various branches of learning cultivated by the people of Hindusthan ruled by his master, the great Akbar. Besides giving an elaborate description of Hindu Laws under the heading *Beyhâr* (*Sans. Vyavahâra*) and referring to "many other sensible books upon government," the compiler of this Moghul Gazetteer gives the following summary of *Râjneet*, "the art of governing a kingdom."

"It is incumbent on a monarch to divest himself of avarice and anger, by following the counsels of wisdom. * * * It is his indispensable duty to fear God * * * to pay particular respect to men of exalted rank and behave with kindness towards his subjects of every description. * * * He should be ambitious to extend his dominions. * * * No enemy is so insignificant as to be beneath his notice. * * * A wise prince will banish from his court all corrupt and designing men. * * *

"The king resembles a gardener, who plucks up the thorns and briers, and throws them on one side, whereby he beautifies his garden, and at the same time raises a fence which preserves his ground from the intrusion of strangers. * * * The king detaches from the nobles their too numerous friends and dangerous dependents. * * *

In affairs of moment it is not advisable to consult with many. * * * Some ancient monarchs made it a rule to consult men of a contrary

[1] Gladwin's Translation, Vol. III (1786) pp. 104-213.

description and to act diametrically opposite to their advice. * * * They found it the safest way to join with the prime minister a few wise and experienced men, and to require each to deliver his opinion in writing. A prince moreover requires a learned astrologer and a skilful physician. * * * If any monarch is more powerful than himself he continually strives to sow dissension among his troops; and if he is not able to effect this, prudently purchases his friendship. * * * The prince whose territory adjoins to his, although he may be friendly in appearance, yet ought not to be trusted; he should always be prepared to oppose any sudden attack from that quarter. With him whose country lies next beyond the one last-mentioned he should enter into alliance; but no connexion should be formed with those who are more remote. If he finds it necessary to attack his enemy, he should invade his country during the time of harvest."

Here we have from a foreign source the traditional ideas of the Hindus regarding Constitution, International Morality, etc., as preserved in the Hindu literature of the 16th century A. D.

Section 4.

Unity and Diversity in Indian National Life.

There are, no doubt, some floating ideas which are common to almost all these treatises and seem to have been the stock-in-trade of every writer on *Nîti*. These verbatim reproductions or occasional modifications and adaptations of the same texts are not difficult to explain. The language of the learned world was the same throughout India. Education was imparted orally, and ideas were transmitted for generations from mouth to mouth. Besides, the incessant political changes of the times also promoted a uniformity of culture. Dynastic revolutions, territorial expansion and contraction, transfers of royal seats from place to place, emergence of new areas into political importance, constant transformations of the "old order yielding place to new"—all these tended to produce an elasticity and flexibility of the Indian mind ever ready to receive new impressions by facilitating *rapprochement* and intercourse among the people.

But beneath these unities and uniformities of culture are to be found the varieties and diversities which are the characteristic products of particular epochs and areas. A close study of the political maxims embodied in the various branches of Hindu literature is calculated to yield not only a history of the *development* of polity and political speculation in India, through the ages, but also a record of the varying geographical influences bearing upon it.

This characteristic of Indian national culture in its socio-political aspects, *viz.*, the super-imposition, upon a fundamental bed-rock of uniformity, of a diversity adjusted to the conditions of varying localities and relative to the changes in the dynamic world-forces—has been also pointed out in my papers on a socio-religious festival called *Gambhirâ* connected with the *Śaiva*-

cum-Śâktaism of Bengal.[1] In fact, "the diversity that characterises the customs and festivals, hymns and rituals of the people in different parts of India in the self-same socio-religious institution is so great to-day that it is difficult to perceive the unity underlying them."

The relativity and diversity of national ideals and institutions modifying the traditional unifying agencies have been thus explained: "The kaleidoscopic political changes which shifted the vital centres of gravity from people to people, province to province, and district to district, necessarily converted the border-lands or buffer-states of one epoch into prominent seats of political and cultural life in the next, and occasionally diverted the stream of paramount ideas along new and untrodden channels. These are hardly visible to us to-day because of the paucity of historical details bearing on them. On the other hand, the translation of higher culture into the tongues of the people of the various parts from the common storehouse of Sanskrit, the *lingua franca* of educated India, through the ages, and the necessary modifications or adaptations, have imparted a local colouring and distinctive tone to the all-India Hindu traditions, sentiments and customs in the several parts of the country."

"Social and religious life of the people of India have thus been for ages governed not simply by the texts of the Sâstras in Sanskrit (which, by the bye, could not escape the natural adaptation to the conditions of time and place), but also really and to a powerful extent by the vast mass of different vernacular literatures, both secular and religious, that grew up side by side with, and eventually replaced, to a considerable extent, the original storehouse."

SECTION 5.

Preliminary Spade-work.

So far as the Hindu Literature on Economics, Public Finance, Constitution, Jurisprudence, and International Law is concerned, the proper analysis of the documents with the object of discriminating from the permanent and basic foundations of unifying thought and tradition the layers and sediments that point to different epochs and diverse local conditions in Indian culture-history, has yet to be undertaken.

And the problem of assigning a particular political code to a particular kingdom or empire cannot be solved before a vast amount of spade-work is done. In the first place, the political history of India has to be ransacked so as to give more or less complete pictures of the administrative machinery and economic organisation of the various kingdoms and empires of the Hindu world. Mr. Krishnaswamy Aiyangar has given a good survey of the whole administrative system of the Cholas[2] (900-1300, A.D.) in his *Ancient India* by utilising inscriptions and Tamil manuscripts. Mr. Akshaya Kumar Maitra has

[1] A *Northern Form of the Śaiva Cult* in the *Modern World* (Madras) for October 1913.

[2] See also *Polity Ancient and Mediæval in Kerala*—(Modern Review, December 1918) by Venkataraya Iyer.

thrown out some suggestive hints regarding the Land Revenue Policy and agricultural tenures under the Pâla Empire. The materials in the possession of the Vârendra Research Society are likely to yield a more satisfactory and complete picture of the mediæval administrative system in Eastern India.

In the second place, the whole field of Indian Literature, both Sanskrit and Vernacular, has to be ransacked wide and deep to discover socio-political and socio-economic treatises, and their contents minutely analysed and elaborately indexed in the interest of comparative studies. Mr. Narendranath Law's *Studies in Ancient Hindu Polity* has revealed certain features of Maurya administration described in the *Arthasâstra* of Kautilya. Mr. Kashi Prasad Jayaswal's essay on the *Introduction to Hindu Polity* published in the columns of the *Modern Review*, is a historical survey of Hindu political thought. Though premature as such, it is well calculated to suggest and open up new fields for the careful consideration of those who are interested in the theory of political progress and development of politics and in the history of political science as a special branch of world's philosophical literature.

The present work is an attempt at placing some of the data of socio-economic and socio-political life gleaned from a text-book of Hindu Sociology.

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CHAPTER II.

THE DATA OF ANCIENT INDIAN GEOGRAPHY.

SECTION 1.

Sukraniti as a source of Geographical Information.

The work of Sukrâchâryya is not a historical *kâvya* like the *Râj Tarangiṇi* or 'Annals of Kashmir' in Sanskrit by the poet-historian Kalhana, which, according to Mr. Stein,[1] "is not only the amplest but also the most authentic of our sources for the geography of Kashmir," and 'by far the richest source of information' for its historical geography. It is not an *Itihâsa*,[2] 'which narrates past events in and through the stories of the actions of the kings.' The description of courts and palaces, forts and temples, or of the circumstances attending the foundation of towns, villages, estates, shrines, mathas and other religious structures by particular kings, or the narrative of expeditions, warfares, sieges, etc., undertaken in quest of territorial expansion are quite uncalled for in the *Nitisâstra*. Here the author has no opportunities for describing the physical background of the hero's exploits by referring to the relief, mountains, rivers, character of soils, seasons, weather, climate and such other natural agencies as promote or retard the activities of man. It is not even a *Purâna*[3] also, which according to the orthodox definition must contain "an account of the creation, the destruction, the dynasties, the cycles or epochs and the incidents or events under each dynasty." There is thus no scope in it for popular story-telling and attractive descriptions likely to catch one's imagination or for rambling from subject to subject and charming digressions about the plants, animals, physical features, geological facts, etc., that come in the way. Nor is *Sukraniti* an ordinary *kâvya*[4] like, say, the *Raghuvamsam* of Kâlidâsa, which must "appeal to the various *rasas*, *i.e.*, feelings or tastes and give rise to pleasure" according to canons of Hindu literary art, and may be diversified in style by images, similes, metaphors and other forms of *alamkâra* or figures of speech, as well as enriched by historical narratives or matter-of-fact descriptions, fanciful pictures or details of men and things according to the writer's genius and sense of proportion. But *Sukraniti* is in verse only because almost every bit of Sanskrit literature is so; there is here no scope for flights of imagination or embellishments of style.

The physiography, topography, mineralogy and meteorology of a place that are more or less expected in works like these have no natural place in a *Nitisâstra*. Among the thirty-two *vidyâs* or sciences mentioned by Sukrâchâryya in the third section of the fourth chapter of his work, there is no

[1] Stein's Râj Tarangiṇi, vol. 2, p. 366.
[2] Sukra IV, iii, 104-5.
[3] Sukra IV, iii, 102-3.
[4] Sukra IV, iii, 110-1.

mention of *Nitisâstra.* But the scope he has defined for his Sâstra at the commencement of the treatise and the manner in which he accomplishes his task lead one to believe that *Nitisâstra* is either identical with, or a species of, the more generic *vidyâ,* the science of *Arthasâstra,*[1] which is defined to be that "which describes the actions and administration of Kings in accordance with the dictates of Sruti and Smriti, as well as the means of livelihood in a proper manner," and is thus politics and economics combined. It is what in modern phraseology would be called a 'normative' science dealing with what 'should be' as opposed to what 'is' or 'has been,' since it dictates and prescribes 'duties' for kings, princes and statesmen. In such a work we cannot expect anything but the 'generalisations,' or what appear to be generalisations, regarding kingly functions deduced from the experience of many states in the past and the present; and therefore references to particular or individual men and places are few and far between, incidentally called for in the interest of illustration.

The very scope and nature of *Sukranîti,* therefore, prevent it from being a source of geographical information, and the author or authors of the work have conscientiously done their part by avoiding all unnecessary or superfluous details except such as are directly and indirectly relevant to the socio-economic and socio-political topics. In studying the geographical environment of the locality in which the work was composed or the court was situated one has, therefore, to pursue the same method as is used in the study of Shakespeare, who always hides himself and eludes the reader's grasp. It seems almost a hopeless task to catch the personality of Shakespeare or Kâlidâsa, because in them there is 'Nature's plenty.' It is an interesting fact about Kâlidâsa that to-day he is claimed by all the four quarters of India as belonging to each. Kashmir and Malabar, Guzarat and Bengal, the extreme north and the extreme south, the extreme west and the extreme east—all vie with each other in finding from the 'internal evidences' of the works of Kâlidâsa that they are the products of a man born and bred in their surroundings.

The geographical facts and phenomena in *Sukraniti* have to be studied, therefore, not only to fix upon the locality in which it might have been written, but also for the knowledge that the poets of the Sukra cycle or authors who chose to adopt the *nom-de-plume* of Sukrâchâryya have incidentally displayed regarding the plants, animals, minerals, rivers, forests, soils, seasons, &c. of India and the world outside it.

SECTION 2.

General Geographical Facts.

(*a*) *The Quarters and Divisions of India.*

The directions of the world, as indicated by the points of the compass, have been mentioned several times in the course of the work. In connection with the construction of the capital city[2] and the royal residence or palace

[1] Sukra IV, iii., 119-20. [2] Sukra I, 425-515.

and officers' quarters, &c., Sukraniti is very particular about the directions, northern or southern, eastern or western, that are to be specially set apart for particular rooms or houses. Thus towards the east the king should have houses for the washing and cleaning of clothes &c. The northern rooms are set apart for chariots, arms and weapons, &c. The museum is to be situated towards the north of the palace. And so on. Or again the northern and southern sides are to be long, twice or thrice the eastern and western sides. The palace is to have sides of equal length in all directions and to be high. southwards and low northwards. The rooms of the rest-houses may face the north or east. In *Vâstu-Sâstras*, or Hindu treatises on buildings, the directions must be mentioned with particular care, because each is supposed to be presided over by a deity, (*e.g.*, Kuvera, or the god of fortune, is the lord of the north, Yama or Death is the lord of the south, and so on). Hence, each direction has a special value affixed to it over and above the ordinary secular significance which arises from the fact that human life and comfort are affected by the sun, the wind and other natural agencies. The subject has been elaborately treated in that celebrated mine of information regarding things Indian, called the *Brihat Samhitâ* as well as the socio-economic manuscript, *Yukti Kalpataru.*

Besides this mention of directions which, according to Hindu tradition, is mainly of a social and religious character, *Sukraniti* contains references to the north, south, east, west and middle as points or regions which take the reader out of the purely local surroundings of a particular spot. The geographical horizon of the poets of the Sukra cycle can be inferred to a certain extent from one of the functions of the *Sachiva*[1] or Head of the War Office, among the Ten *Prakritis* or Executive Councillors of the state, which is described to be that of studying the men who are sent eastward and westward on missions. This mention of 'eastward and westward,' however, does not furnish any solid ground as to the particular regions meant, for it has been done in connexion with a general statement. But the references to the 'north and west' as the land of the Yavanas[2] who "recognise authority other than that of the Vedas," to the 'southern' countries where Brahmanas[3] are not condemned, if they marry maternal uncles' daughters, to 'Madhyadeśa,' where artisans[4] are beef-eaters, and deviation from the normal customs is not regarded as a sin, and to the 'north'[5] where the women are touchable when they are menstruated, are not only the facts of pure and simple geography, but create in the minds of the reader the shrewd suspicion that the author of these lines does not belong to the particular regions mentioned, and that these must lie beyond the pale of "normal" rules and regulations of social life. In fixing upon the author's home, therefore, one would be naturally tempted to exclude these regions from one's considerations.

It is difficult to make out which regions are specified in these references. The description of India as a country of the *Navakhanda*[6] or Nine Divisions .

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1 Sukra II, 181-190.
2 Sukra IV, iv, 74-75.
3 Sukra IV, v, 94.
4 Sukra IV, v, 25-96.
5 Sukra IV, 5, 97.
6 Cunningham's *Ancient Geography of India* (1871), pp. 5-8.

was first used by the astronomers Parâsara and Varâhamihira, and was afterwards adopted by the authors of several of the Purânas. "The names of the Nine Divisions given in the Mahâbhârata and the Purânas differ entirely from those of Varahamihira; but they agree with those of the famous astronomer, Bhâskarâchâryya." But "the division of India into five great provinces would appear to have been the most popular one during the early centuries of the Christian era, as it was adopted by the Chinese pilgrims, and from them by all Chinese writers. According to Vishnu Purâna the *centre* was occupied by the Kurus and Panchâlas; in the *East* was Kâmarupa or Assam; in the *South* were the Pundras, Kalingas, and Magadhas; in the *West* were the Saurâstras, Suras, Âbhiras, Arbudas, Karushas, Mâlavas, Sauviras, and Saindhavas; and in the *North* the Hunas, Salvas, Sakalas, Ramas, Ambashtas and Pârasikas." This account of India in the Vishnu Purâna does not include what are comprised by the modern Deccan and Southern India. But "the same division of five great provinces was adopted by the Chinese pilgrim Houen Tsang in the seventh century, who names them in the same manner, as north, south, east, west and central according to their relative positions." The extent and area of each of the five great provinces which according to the tourist's report contained altogether eighty kingdoms are not the same as those in the Vishnu Purâṇa; and Houen Tsang's India is larger than that of the Purâṇa. From Cunningham we quote the following lines which give the territories included within the five great provinces of India in the seventh century A.D.

"I. *Northern India* comprised the Punjab Proper, including Kashmir and adjoining hill states with the whole of Eastern Afghanistan beyond the Indus, and the present cis-Sutlej states to the west of the Saraswati river.

II. *Western India* comprised Sindh and Western Rajputana with Kutch and Gujarat, and a portion of the adjoining coast on the lower course of the Narbada river.

III. *Central India* comprised the whole of the Gangetic Provinces from Thaneswar to the head of the Delta and from the Himalaya mountains to the banks of the Narbada.

IV. *Eastern India* comprised Assam and Bengal Proper including the whole of the Delta of the Ganges together with Sambalpur, Orissa and Ganjam.

V. *Southern India* comprised the whole of the Peninsula from Nasika on the west and Ganjam on the east, to cape Kumari (Comorin) on the south, including the Modern Districts of Berar and Telingana, Mahârâshtra and the Konkan, with the separate states of Haidarabad, Mysore and Travancore or very nearly the whole of the Peninsula to the south of the Narbada and Mahânadi rivers."

Mr. Cunningham believes that the tradition of the five Great Provinces was very popular in ancient India, at any rate among the educated classes. And if the authors of the Sukra cycle followed that tradition in referring to the land of Yavanas and the other regions of customs that would be regarded as immoral and heinous according to the normal standard of life and manners obtaining in the country for which their work was being written, the treatise excludes practically the whole of India from its purview and would have to be referred to some spot in *Eastern India*. But is it probable that the authors have used the *pratyaguttara*, (north and west or north-west ?), the *madhyadeśa*, the *dâkṣiṇâtya* and the *uttara* in the technical sense of the terms as given in either Vishnu Purâna or the Chinese pilgrim's accounts? The

question involves larger issues and cannot be decided before the following problems are solved :—

(1) The Ethnology of the Yavanas and their Philosophy.

(2) The regions and races which allowed beef-eating to artisans and artists and fish-eating to men.

(3) The regions and races which allowed the marriage of maternal uncles' daughters by Brahmaṇas.

(4) The regions and races which did not consider female menstruation as a pollution.

(5) The regions and races which did not object to the drinking of wines by women.

(6) The regions and races in which unchastity was not regarded as a sin.

YAVANAS.

If we are to determine the geography of the Yavanas after solving the question of their race and religion, the problem will not be solved at all. The *Yavanamata*[1] or the philosophy of the Yavanas has been described in *Sukraniti* as the thirty-first *Vidyâ* "which recognises God as the invisible creator of this Universe and recognises virtues and vices without reference to *Sruti* and *Smriti*, and which believes that *Sruti* contains a separate religious system." This description of Yavanism as a non-vedic, monotheistic religion is 'too wide', and as Mr. Oppert discusses in his short Preface to the Text of *Sukranîti Sâra*, published by the Madras Government in 1882, may be made to apply (1) to the Mosaic religion, (2) to Mahometanism, (3) to Christianity, (4) to the religion of the ancient Persians ; and even (5) to the religion of the Hindus "who contend that they only revere the god-head in one particular manifestation, but that they do not admit of a plurality of gods." But Mr. Oppert's contention that *Yavanamata* may refer even to Hinduism is certainly erroneous, since no form of Hinduism ignores *Sruti* and *Smriti* and believes that Sruti contains a separate religious system—conditions essential to Yavana philosophy. In any case, to argue definitely from the tenets and doctrines of this creed as to the race and nationality of the people professing it is impossible.

As for the abode or habitat of this race it is mentioned that the people are 'pratyaguttaravâsinah.'[2] This word may be interpreted in two ways according as the compound is taken to be of the *Karmadhâraya* type or of the *Dwandwa* type. In the first case, the Yavanas are a people who live in the north-west. In the second case, they live *both* in the north and in the west (*pratyak*). Mr. Oppert takes it in the first sense. I take it in the second. But either way we are not left any the wiser regarding the religion or the people indicated by the term. For in different ages different peoples professing different faiths, Jewish, Hellenic, Christian, and Mahometan, have been inhabitants of the regions

[1] Sukra IV, iii, 124-126. [2] Sukra IV, v, 74-75.

implied by the north, west, and north-west. The pre-condition for fixing the precise ethnology of Yavanas, therefore, is the exact date of *Sukraniti*, which for a long time yet, is sure to be ' begging the question.'

Dr. Râjendralâl Mitra, in his second volume of *Indo-Aryans* after a protracted disquisition, arrives at the following conclusions regarding the Yavanas:

" That originally the term Yavana was the name of a country and of its people to the west of Kandahar,—which may have been Arabia, or Persia or Medea, or Assyria—probably the last.

(2) That subsequently it became the name of all those places.

(3) That at a later date it indicated all the casteless races to the west of the Indus including the Arabs and the Asiatic Greeks and the Egyptians.

(4) That the Indo-Greek Kings of Afghanistan were also probably indicated by the same name.

(5) That there is not a tittle of evidence to show that it was at any one time the exclusive name of the Greeks.

(6) That it is impossible now to infer from the use of the term Yavana the exact nationality indicated in Sanskrit works."

BEEF AND FISH.

If the above discussion does not leave us on any solid ground as to the geographical facts and phenomena of India, the precise delimitation of areas within which certain abnormal social and religious customs are allowed is none the more easy. Take, for instance, beef-eating, which has been described as the peculiar custom of the artists and artisans of the *madhyadeśa*, or fish-eating, which is described as the special characteristic of the people generally of the same tract. Both in Vedic and subsequent Indian literature the slaughter of animals for food has been repeatedly mentioned. Principal P. T. Srinivas Iyengar writes in his *Life in Ancient India in the Age of the Mantras* :

" Horses (A.V.vi. 71.1), bulls (R.V. i. 164. 43), buffaloes (R.V. 29. 7), rams (R.V. X. 27. 17) and goats (R.V. i. 162. 3) were killed on slaughter-benches (R.V.x.86.18), cooked in caldrons (R.V.iii. 53.22) and eaten. The eating of fishes and birds must have also prevailed."

Dr. R. Mitra also is strongly of opinion that beef-eating was universally allowed in ancient India and proves it by referring to *Uttarâma-charita, Smritis, Manusamhitâ, Asoka's edicts, Mahâbhârata, Râmâyaṇa, Charaka, Suśruta, Kalpa and Grihya Sutras.*

" Âswalâyana emphatically ordains that no *madhuparka* should be celebrated without flesh (?)." The author of the *Nârasinhiya Prayoga-pârijâta* has copied verbatim Âswalâyana's rule about the necessity of eating beef at the Madhuparka ceremony, but qualified it by a quotation from *Âdityapurâna* which says that in the present *kali* age the madhuparka should be celebrated without slaughtering a cow. The quotation has been given at length by Parâsara, Hemâdri and other compilers." " The Brihannâradiya Purâna follows the above very closely."

Both the *Upa-purânas* are, according to Dr. Mitra, not above eleven or twelve hundred years old. The author of the *Nirṇayasindhu* argues :

" The slaughter of large bulls and large sheep for Brahmans versed in the Vedas, though duly ordained, should not be done, being detested by the public."

Dr. Mitra's explanation[1] of the prohibition of beef-eating lies in the fact "that when the Brahmans had to contend against Buddhism, which emphatically and so successfully denounced all sacrifices, they found the doctrine of respect for animal life too strong and popular to be overcome, and therefore gradually and imperceptibly adopted it in such a manner as to make it appear a part of their *Sâstra.*"

The lines in Sukranîti, therefore, referring to the custom of beef-eating as confined within a certain class of people in certain tracts of India called *madhya-deśa* must have been written by a person, if Dr. Mitra's theory is to be accepted, who lived in an environment that had long been disciplined in the sentiments and traditions brought on by the ascendancy of Buddhism. Madhyadeśa, therefore, should mean the land that forsook these humanitarian ideals long before other parts had become callous to them. Eastern India[2] as described in connexion with Hiouen Tsang's travels was the land that received Buddhistic influence earlier and more powerfully than other parts of India, and it may be surmised that the author of the lines referred to was writing from his home in Eastern India about the *Central India* as described in the Chinese itinerary, when he was thinking of beef and fish as food.

Mahâmahopâdhyâya Haraprasâd Sâstri, in his Introduction to Mr. Nagendra Nath Vasu's *Modern Buddhism*, thus bears testimony to the strength of Buddhism in Eastern India :

" Yuan Chuang tells us that there were ten thousand Sanghârâmas with a hundred thousand Bhikshus in Bengal. To support this vast mendicant population at least ten millions of lay families were required, and they would be all Buddhists. ** More than three-fourths of the population of Bengal were Buddhists. Full one hundred years after Yuan Chuang, the original five progenitors of the present Râdhiya and Vârendra Brâhmans in Bengal came from Kanoj. Their religion was not a proselytising one. In the middle of the twelfth century Ballâla Sen took a census of the descendants of these five Brahmins and he found only eight hundred families in all. They lived mostly on grants of land made to them by the Râjâs. * * * But they rarely interfered with other people's religion. * * * The masses were almost entirely left in the hands of the Buddhists, both married and unmarried. * * * The monasteries of Nâlanda, Vikramaśilâ, Jagaddala and other places were the best seminaries for the diffusion of Buddhistic learning and Buddhistic religion. It was from these monasteries that Tibet, Burma, Ceylon and Mongolia received their Buddhist preachers and Buddhist authors and translators. * * * In the twelfth century there were the following forms of religion in Bengal and in Eastern India :—

1. Brahminism. It was followed by 800 families of Râdhiya and Vârendra Brahmins and about a hundred families of other Brahmins, the descendants of many Kâyasthas who came from the west and those of lower classes who served the families.

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[1] Indo-Aryans, Vol.II, pp. 354-88.

[2] See the contributions of Mahâmahopâdhyâya Haraprasâd Sâstri to the Journal of the Asiatic Society of Bengal, No 1. 1895, and Proceedings of the Society for December, 1898. Pandit Sastri has explained " *how the religion which existed in Eastern India in such splendour from 600 B. C. to 1200 A. D.*" has under the influence of new conditions continued to exist there in new names under various guises even to the present day. This latter aspect of the question has been discussed by Mr. Nagendranath Vasu also in his *Modern Buddhism.*

2. Hinayâna. This was followed on the West of the Ganges and especially in Tamluk.

3. Mahâyâna. It was a religion of the higher class Buddhist monks and higher class Buddhist laity.

4. Vajrâyana. This was the religion of the middle class man and the married Buddhist clergy.

*5. Nâthism, which was professed by the Yogis who had numerous followers amongst the Buddhists and a few among the Brahminists.

6. The Sahajiyâ cult. It had numerous followers below the middle-class Buddhists and some among the lower class Brahminists.

7. Tântrism. It had its followers among all classes, but among the higher classes it was a subsidiary form of worship, among the lower it was the chief form.

8. The Kâlachakrâyana. It was purely Buddhist and more a religion of fear than of love and was followed by the lowest classes."

Mr. Dineschandra Sen, also, in his celebrated *History of Bengali Literature* (both in Bengali and English) has adduced fresh facts in support of the Sastri's theory about the survival of Buddhism among the lower orders in Eastern India. He has referred to Bengali works of the period from 13th century, the age of the so-called annihilation of Buddhists by the Musalmans, to the 17th century. Nagendranath Vasu's *Modern Buddhism* is an account of still extant forms of that cult in the hill-tracts of Orissa. In Mr. Sen's monumental work we have been supplied with some of the more important features of Buddhistic faith that may be detected from an analysis of (1) the *Sunyapurâṇa* of Râmâi Pandit published by the Bangiya Sâhitya Parishat of Calcutta, (2) the Bengali passages occurring in the Sanskrit works of 10th-11th cent., (3) the *Charyâ charyavinischaya* of Kânu Bhatta, discovered by the Sastri in Nepal, (4) the Lay of Mânikchând published in the Journal of the Asiatic Society of Bengal (belonging according to Grierson, to the 14th, but according to Sen, to 11th-12th cent.), (5) the folk-songs about Govinda Chandra compiled by a rustic poet, (6) the agricultural maxims of Khanâ, and (7) astrological lore of Dâka, both of which must be considerably anterior to Mânikchând.

Another scholarly and highly original Bengali publication of recent times which throws a flood of light on Mediæval Buddhism and the processes of transformation by which it merged into, and was replaced or considerably eclipsed by, Hinduism is the history of *Gambhirâ*,[1] a Śaiva festival of the people in North Bengal, by Mr. Haridâsa Pâlit of the District Council of National Education, Malda. This work may be looked upon more or less as a connected history of socio-religious life of Eastern India. The researches embodied in it go further than supplying new data corroborating the hypothesis of the Sastri; for it proves

[1] The materials supplied by Mr. Pâlit in this learned work from a first-hand study of innumerable Bengali and Sanskrit Mss., traditions and folksongs as prevailing in North and West Bengal (called *Varendra* and *Râdha*) as well as Orissa have been utilised by the present author for his forthcoming work, "Studies in Hindu Literature—Literary and Sociological." A few chapters from this have been published in *The Vedic Magazine* (Hardwar), *The Modern World* (Madras), and *The Collegian* (Calcutta).

that the worship of Śiva by the orthodox Hindus of to-day with such peculiar constitutional, doctrinal and devotional features as are associated with the *Gambhirâ*, *Gâjana* and other ceremonies, is nothing different from, but really a descendant or another form of, the worship of Dharma, the mediæval Buddha, popularised by Râmâi Pandit, and that the whole laboratory of Buddhalogy and paraphernalia of Buddhistic ceremonialism have been utilised by and transformed into the modern socio-religious institutions of the Hindus. Modern Śaiva-cum-Śâktaism is thus traced by the author through the Yoga-Tantric phase of Mahâyâna-cum-Brâhmanism back to the Vedic period of the simple worship of Rudra, Rudra-agnis, &c.

That Buddhism was decaying in Central and Southern India, while it flourished vigorously in Bihar and Bengal, would be evident from the following extracts from Mr. Vincent Smith's *Early History of India* :

"The Brahmanical reaction against Buddhism had begun at a time considerably earlier than that of Fâhion's[1] travels (405—11 A. D.); and Indian Buddhism was already upon the downward path."

"Buddhism was visibly waning in the days of Harsha and Houen Tsang. * * * It had certainly lost its dominant position in the Gangetic plain which it had once held. * * * The sacrificial form of the Hindu religion received special attention. * * * Buddhism as a popular religion in Bihar, its last abode in Upper India, south of the Himalayas, was destroyed once and for all by the sword of a single Mussalman adventurer (1193 A. D.)."

According to Dr. Mitra, therefore, the prohibition of beef and meat as food and the consideration of people taking to them as following an abnormal practice must be ascribed to the influence of Buddhistic environment in Eastern India as I have suggested above.

Maternal Uncle's Daughter.

The marriage and other social customs mentioned above do not raise many difficulties. Among Marathas and Madrasis, even to-day, Brahmans may marry maternal uncle's daughters—an abnormal custom according to Sukra. The tradition is preserved in a familiar Sanskrit sloka ' dakṣiṇe mâtuli-kanyâ, uttare mânsabhojanam,' which describes the southern custom regarding marriage together with the northern regarding meat as food. The term Dâkṣiṇâtya, therefore, used in the *Sukraniti*, for the abode of such Brahmans as follow this abnormal custom, refers both to what is now called the Deccan plateau as well as Southern India, as it did according to the division of India into five great provinces in Houen Tsang's time. There is no doubt that by this term the Northerner (or East Indian ?) Sukra refers to the Deccani (Châlukya, Râṣtrakuta), Andhra (Telugu) and Chola (Tamil) Brahmans of his age.

Wines.

As for what Sukrâchâryya considers to be the abnormal practice of the drinking of wines by females, definite information on the point is not easily available. Dr. Mitra has proved the practice to be universal by references to the Râmâyaṇa, Mahâbhârata, Buddhist works, the works of Kâlidâsa and Mâgha,

[1] Second Edition, pp. 283, 287, 318, 370. See also Aiyangar's *Ancient India*, p. 362.

Purânas and Tantras. But the fact that it should be regarded as exclusively the practice of the female sex of a particular country cannot be satisfactorily explained in the present state of our knowledge regarding the social life of ancient and mediæval India. Sukra may, therefore, be taken at his word when he mentions the north as the locality of the custom. And there is no objection to referring this north to the northern division of Hiouen Tsang.

The same arguments apply to the non-observance of menstruation as ceremonially unclean, and yield the same conclusions about its locality.

UNCHASTITY.

The unchastity of women[1] has been referred to several times in Vedic and other Hindu literature. But it is not easy to locate it somewhere as the area in which it is particularly connived at. Sukra's statement that it is the characteristic of the women of Madhyadeśa may, therefore, be taken for what it is worth. And in the absence of positive evidences for or against, this madhyadeśa may be taken to be the *Central India* of the Chinese pilgrim.

EAST INDIAN LOCALE OF SUKRANITI.

The study of the directions and divisions of India mentioned in the Sukraniti leads to a tentative hypothesis as to the home of the authors of the Sukra cycle. We have to fix upon a region, *with reference to which* the writer may simultaneously mention the north, west, central and south, as the quarters or divisions where certain customs and practices obtain which "deserve penance" and punishment" in the normal region that sets the standard.

No Southerner would regard a southern practice as out of the way and beyond the 'norm.' The same consideration applies to the westerner, northerner, &c. The only region or quarter that has *not* been mentioned must therefore be the land of Sukra's 'normal' social life, and this is the Eastern.

The argument from the 'abnormal' practices leaves no doubt as to the normal region in which the treatise was composed. As to the spot also with reference to which the quarters of India and the positions of the regions are mentioned, there can be no difficulty. We may place it in Eastern India, if we suppose that north, west, centre and south were being mentioned in the technical sense of the terms as used by Hiouen Tsang. The Easterner versed in technical terminology would mean by north not the Tibetan Himalayas, but the Punjab and Kashmir, Himalayas, &c., by the west not the modern U. P. but Sindh, Rajputana, &c., by the central the regions marked out by Hiouen Tsang comprising U. P., Behar, C. P. of modern times, and by the south the whole of South India beyond the Narbada. The *Madhya* (centre) would thus always be the centre of India, the North always the North of India, the *Dâkṣiṇâtya* or South the whole of Southern India.

But one might argue that, if the technical meaning of the terms be taken, there can be no objection to the author of the lines referred to being a southerner also, say a Chola or an Andhra, belonging to any part of India, for he is

[1] Iyengar's *Life in Ancient India*, pp. 67-68. [2] Sukra IV, v, 99.

at liberty to use the terms in the same sense from all places. The objection is refuted by the other consideration about the normal and abnormal customs just discussed. Thus though the Southerner may call the man of the Punjab and Kashmir, &c., northerners in the special sense, and the other parts of India excluding Râjputânâ, &c. on the west and Bengal, &c, on the east by the special name of Central India, and describe himself as a southerner in the technical sense given with reference to the whole of India (which is not likely), it is not at all probable that he would look upon the southerners, or his own countrymen as illustrating a social practice that is beyond the 'norm.' The same consideration goes against the author being a 'north'-man or a 'Madhyadeśa'-man.

This process of reasoning is adopted by George Buhler[1] to prove that Âpastamba is a southerner. Thus, "Âpastamba says (Dh. II, 7, 17, 17) that the custom of pouring water in the hands of Brahmanas invited to a Srâddha prevails among the northerners, and he indicates thereby that he himself does not belong to the north of India. If this statement is taken together with the above stated facts which tend to show that the Âpastambiyas were and are restricted to the south of India, the most probable interpretation which should be put on it is that Âpastamba declares himself to be a southerner."

(*b*) *Other Lands.*

Whatever be the value of the hypothesis as to the author of *Sukranîti* being an Easterner, as understood by the Chinese pilgrims, and also by the Indians of the early Christian era, one thing is clear. The geographical knowledge displayed by Sukrâchâryya is not confined to a particular area. The poets of the Sukra cycle are not home-bred men, their intellectual horizon covers the whole of India. They can think at once of the four quarters of the motherland, even though conventionally. This has been apparent from the discussion in the preceding sub-section.

That they were cognisant of 'new men, strange faces, other minds' and did not think exclusively of the local area that was the scene of their activities would be indicated by several passages in the Sukraniti, which mention, though indefinitely, regions, religions and languages other than their own. Thus among the qualifications of the clerk or scribe[2] is mentioned that of "knowing of the differences in countries and languages." The statement that the system of measurements[3] varies with countries points to the same experience of the writer beyond his own 'country.' The practice of undertaking distant tours is suggested by the advice that "in foreign lands the following six are useful to men—wife without child, good conveyance, the bearer, the guard or guide, the knowledge that can be of use in relieving others' miseries, and an active servant."[4] This practice of travel and life abroad is also indicated by the idea that "the man[5] who is not in a strange

[1] Pp. xxviii-iv. Introduction to *Apastamba and Gautama* in the Sacred Books of the East Series.

[2] Sukra II, 347-348 ; IV, 81-82.

[3] Sukra II, 777-778.

[4] Sukra III, 505-597.

[5] Sukra III, 647.

land enjoys happiness." The prohibition of foreign travel[1] to Sudra females, except in the company of the husband, similarly points to this. The comfort of living in the home and the discomfort of life and work abroad have been mentioned as factors which influence the soldiery also. Thus alienation of soldiers[2] is brought about by constant life and work in foreign lands." The rule about 'travelling allowances' is another proof of experiences beyond the little 'platoon.'

These references, however, do not furnish any geographical information worthy of note. Nor do they point to anything like an all-India sentiment or knowledge or any extra-Indian experience. These are but vague and indefinite hints about things that are not purely local.

(c) *Definite Names.*

It has been mentioned above that as sources of positive geographical information, *Nītiśāstras* are not very valuable. This is sufficiently borne out by the fact that only the following five names occur in *Sukranīti*, a work of 4966 lines: (1) Simhala or Ceylon, (2) Gandaka, (3) Dākṣiṇātya, (4) Madhya-deśa, (5) Khaśa.

i. *Simhala*

Ceylon[3] has been mentioned as an island, and its people are described as expert in making artificial pearls which should be carefully examined by customers before purchase. The connexion of Ceylon with general Indian history is immense and has been commercial, political, as well as cultural. Prof. Rādhā Kumud Mookerji[4] has, on the authority of Buddhist texts belonging to a period of a thousand years from 600 B. C., given evidences "which point to a complete navigation of the Bay of Bengal and the Indian Ocean and the flow of a steady and ceaseless traffic between Bengal and Ceylon, Madras and Burma." Mr. S. Krishnaswami Aiyangar of the Mysore Education Service in his *Ancient India*, a scholarly work on the early history of South India, has used old Tamil literature to prove the connexion of the Ceylonese with the Cholas, Cheras and Pāndyas in particular, and Indian culture in general. Mr. Cunningham's account of Ceylon in *the Ancient Geography of India* also throws fresh light on the subject:

> "The famous island of Ceylon is not reckoned amongst the kingdoms of India, and it was not visited by the pilgrim (Houen Tsang) on account of political disturbances. * * * In the seventh century of our era Ceylon was known by the name of *Seng-kia-lo*, or *Sinhala*, which was said to be derived from the lion-descended *Sinhala*, whose son Vijaya is fabled to have conquered the island on the very day of Buddha's death in B. C. 543. Its original name was *Paochu*, or "Isle of Gems," in Sanskrit *Ratnadwipa*."

ii. *Gandaka.*

The Gandaka[5] has been mentioned as a source of gems which may be regarded as natural images. The neighbourhood of the Gandaka is famous in

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[1] Sukra IV, 0-10. [2] Sukra IV, vii, 306-307. [3] Sukra IV, ii, 124

[4] A History of Indian Shipping and Maritime Activity of the Indians (Longmans, 1912), pp. 29, 30, 34, 42, 44, 67, 70, 103, 113, 133, 140, 142, &c.

[5] Sukra, IV, iv, 507-308.

Buddhist history as it contains the environs of Kusinagara, the scene of Buddha's death. At the time of Houen Tsang's visit the walls of Kusinagara were in ruins. According to Cunningham the spot where Buddha obtained *Nirvâṇa* "lies to the north-west of Anrudhwa, and to the west of the old channel of the Chota Gandaka[1] or *Hiraṇyavati* (golden) river;" and "the spot where his body was burned" lies to the north-east of Anrudhwa and to the east of the old channel of the *Hirana* or Chota Gandaka." We must look for *Vaisâli* to the East of the Gandaka." The position of the Gandaka may be inferred from the following description:[2] "The utmost limit that can be assigned to the joint districts (Vaisâli) is not more than 750 or 800 miles in circuit from the foot of the mountains to the Ganges on the south, and from the Gandaka on the west to the Mahanadi[3] on the east." "According to Houen Tsang the country of the Vrijis was long from east to west and narrow from north to south. This description corresponds exactly with the tract of the country lying between the Gandaka and Mâhanadi rivers, which is 300 miles in length and 100 miles in breadth."

It is possible to trace the tradition of gems being found in the bed of the Gandaka to literary[4] sources. Perhaps the name of the river as *Hiran* and *Hiraṇyavati*, which means golden, may have something to do with it. Small pieces of stone which are worshipped as Viṣṇu are still found in the bed of the Gandaka, and they are highly appreciated.

The following is taken from the note on page 3 of *Ethnographic Notes in Southern India* by Edgar Thurston, Superintendent, Madras Government Museum: "The Sâlagrâma stone is a fossil ammonite, found in certain rivers, *e.g.*, Gandaka, Son, &c., which is worshipped by Brahmans. The Sâlagrâma is often adopted as the representative of some god, and the worship of any god[5] may be performed before it."

The following is taken from Mr. Nandalal Dey's *Geographical Dictionary of Ancient and Mediæval India*:[6] "The Gandak rises in the Sapta Gandaki or Dhawalagiri range of the Himalaya which is the southern boundary of Central Tibet, and enters the plains at a spot called Tribeni Ghat. The source of the river is not far from Sâlagrâma, which was the hermitage of Bharata and Pulaha. The temple of Muktinâtha (an image of Nârâyana) is on the south of Sâlagrâma. Hence the river is called also Sâlagrâmi and Nârâyaṇi (*Brahmavaivartta Purâṇa*)."

[1] Ancient Geography of India (1871), p. 432. Kushinagara has been recently discovered by Pandit Hirânanda of the Lucknow Museum at the village called Cassia in the district of Gorakhpur, U. P.

[2] Cunningham's *Ancient Geography*, pp. 444, 448.

[3] The Mahânadi is the modern Mahânandâ flowing through the district of Malda which contains the sites of ancient Gauda and Pandua, and not the Mahânadi of Orissa.

[4] Devi Bhâgavata IX, 17, 30-36, IX, 19, 87-91, IX, 23, 23-38, IX, 24, 56-58.

[5] See the names and forms of the deities on pp. 348-349 of Oppert's *Original Inhabitants*.

[6] Pp. 19-20. (Newman & Co., Calcutta, 1899).

In *The Original Inhabitants of India*[1] by Mr. Gustav Oppert we have a long dissertation on the Sâlagrâma and the Gandaka—with all the literary and religious traditions associated with them. In the *Varâha Purâṇa* Gandaki expresses a wish to become the mother of Viṣṇu, and the same desire is mentioned in the *Lakshmi Nârâyana Samvâda.* The *Padma Purâṇa* contains a story according to which Indra sent the nymph Manjuvâc to disturb the penance of the sage Vedasiras, who cursed her that she might become a river, but kindly altered his decision in so far that she would become the holy river Gandaki in which Viṣṇu would be re-born as the Sâlagrâma stone.

iii. *Dâkṣiṇâtya.*

Dâkṣiṇâtya[2] has been mentioned in *Sukranîti* as the land where Brahmans marry maternal uncles' daughters. This has been discussed previously in connexion with the directions and divisions of India. It may be mentioned here that the term does not describe any one portion of India south of the Vindhyas, *e.g.*, the Bombay Deccan and the Madras Deccan, but the whole peninsula, and comprises all the nine separate kingdoms, exclusive of Ceylon, included in Houen Tsang's Southern India, *i.e.*, "the whole of the peninsula to the south of the Tâpti and Mahânadi rivers, from Nâsik on the west, to Ganjam on the east." What is now known as the Deccan plateau or at any rate, the Bombay section of the Deccan, had in Houen Tsang's time, the special name of *Mahârâṣṭra* and could not be described by the term *Dâkṣiṇâtya.* Mahârâṣtra[3] was only one of the kingdoms of the *Dâkṣiṇâtya* or Southern India as described by Houen Tsang, and lay to the south-west of Harṣavardhana's empire, as Ganjam to the south-east.

The following lines from the third section of the *Early History of the Deccan* by Sir Râmkrishna Gopâl Bhândârkar prove the antiquity of the word *Mahârâṣṭra* as a separate name for a particular region of peninsular India :—

"Whether the name Maharattha or Maharashtra had come into use in the time of Asoka does not appear clear from this, but that it was used in the early centuries of the Christian era admits of little doubt. In some inscriptions in the cave-temples at Bhâjâ, Bedsâ and Kârli which are to be referred to the second century, the male donors are called Maharathi and the female Maharathini......Of the old Prâkrits the principal one was called Maharashtri because we are told it was the language of Mahârâshtra. Varahâmihira also, who lived in the beginning of the sixth century, speaks of Mahârâshtra as a southern country."

In explaining the etymology of the word "Dekkan" and its denotation, the same authority says :

"The word Dekkhan represents the vernacular pronunciation of the Sanskrit word Dakshiṇa meaning 'Southern' used to designate the portion of the Indian peninsula lying to the south of the Narmadâ. The name more usually met with in Sanskrit works and elsewhere is Dakshinâpatha or "the southern region." That this name was in

1 Pp. 337-59 (Archibald Constable and Co., London, 1893).

2 Sukra IV, v, 94.

3 Cunningham's *Ancient Geography*, p. 14.

ordinary use in ancient times is shown by the fact that the author of the *Periplus* calls that portion of the country Dakshinabades. * * * Dakshinapatha or Dakshina was the name of the whole peninsula south of the Narmada. Among the countries enumerated in the Mârkandeya, Vâyu, and Matsya Purânas as comprised in Dakshinâpatha are those of the Cholas, Pândyas and Keralas, which were situated in the extreme south of the peninsula and correspond to the modern provinces of Tanjor, Madura and Malabar."

Dākṣiṇātya is therefore not identical with Mahārāṣtra, as the popular notion seems to be, in which sense Sir Bhandarkar has taken it for his celebrated *Early History.* A historical account of peninsular India or the Dākṣiṇātya has been written from original sources by Mr. Aiyangar in *Ancient India*,[1] from which the following is quoted :

"When Yuwan Chwang (Hiuen Tsang) travelled through the country in A.D. 640 we find India marked out into three clearly defined political divisions. Harshavardhana......ruling over Hindusthan to the frontiers of Assam ; Pulikesin II of the *Mahārāshtra* at Badami with his younger brother at Rajamahendri ; and Narasimhavarman Pallava at Kanchi." "These two dynasties (Châlukya and Pallava) with their capitals respectively at Kanchi and Badami (near Bijapur) continued the struggle for empire and were seen fighting constantly on the Tungabhadra-Krishna frontier."

iv. *Madhyadeśa.*

The probable site of *Madhyadeśa* also has been discussed in connection with the directions and divisions of India. I have taken it in the technical sense of the term as understood in Houen Tsang's time. "It extended from the Sutlej to the head of the Gangetic Delta and from the Himalaya mountains to the Narbada and Mahānadi rivers. It comprised all the richest and most populous districts of India with the single exception of the Gangetic Delta or Bengal proper. Of the seventy[2] separate states of India that existed in the seventh century, no less than thirty-seven, or more than one-half, belonged to central India." Manu Samhitā, however, defines Madhyadesa to be the land between the Saraswati (that loses itself in the sands) on the west and Allahabad on the east, and between the Himalayas on the north and the Vindhyas on the south. The tract is thus smaller in extent than Houen Tsang's area. But, as previously explained, it is difficult at present to specify the region meant by the authors of the Sukra cycle. It is clear, at any rate, that it cannot denote the land of aboriginal hill-tribes in the Central India of modern times, simply because beef-eating, fish-eating and unchastity have been mentioned as some of the characteristics of its people.

v. *Khaśa.*

Khaśa denotes both country and race in the *Sukranīti.* Khaśa[3] has been mentioned as the country of an abnormal social custom where "people marry the widows of their brothers." Khaśa is an old term in Hindu literature

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[1] P. 224, 43.

[2] Cunningham's *Ancient Geography*, p. 328. The text has "seventy"; but the number actually described is eighty-two, from which, deducting Persia and Ceylon, the true number of kingdoms is eighty.

[3] Sukra IV, v, 98.

mentioned in Viṣṇu Purâṇa, Manu Samhitâ, &c. The following extract from Stein's *Râj Taranginî* throws considerable light on this people: "In the South and West (of Kashmir) the adjacent hill-regions were occupied by Khaśas. Their settlements extended as shown by numerous passages in the Chronicle in a wide semicircle from Kastvar in the south-east to the Vitasta valley in the west. The hill states of Rajapuri and Lohara were held by Khasa[1] families; the dynasty of the latter territory succeeded to the rule of Kashmir in the eleventh century. I have shown elsewhere that the Khaśas are identical with the Khakha tribe, to which most of the petty chiefs in the Vitasta valley below Kashmir and in the neighbouring hills belong. We have already seen that the Khakhas have until very recent times worthily maintained the reputation which their forefathers enjoyed as marauders and turbulent hill-men." "Owing to its position on the most direct route to the Pûnjab, Rajapuri was necessarily often brought into political relations with Kashmir. When Houen Tsang passed through it, the kingdom of Rajapuri was subject to Kashmir. From the tenth century onwards we find the chiefs of Rajapuri as practically independent rulers." Houen Tsang does not give any account of the hill-tribes he passed through.

It is, however, not possible to make out the antiquity of the word Khaśa. It may be mentioned in passing that the word occurs in the copper-plate of Nârâyana-Palâ[2] discovered at Bhagalpur recording a gift for the "dispensation of medicines to the sick, and food and shelter to the indigent."

SECTION 3.

General Aspect of the Country.

The physical features or relief of the country described in *Sukranîti* can be understood but vaguely from the incidental references to hills and rivers, seas and islands.

(*a*) *Hills.*

That hills and mountains were some of the familiar sights to the poets of the Sukra cycle would be evident from the simile which compares the stature of an elephant with the peak of a mountain[3] as well as the mention of the fact that when people became miserable through abject poverty they used to leave this world out of despair and have resort to hills.[4]

The strategic importance of hills and mountains was also understood. Thus the site of the capital city is to be not very far from the hills.[5] These are perhaps to be regarded as the store-house of mineral and other resources in normal times, as well as strong defences against foreign aggression in times of danger. That the hills should be made to serve the purpose of ramparts for the capital situated in the plains is clear from the following suggestion of

[1] Stein's *Râj Taranginî*, Vol. II, pp. 430, 433.

[2] Mitra's *Indo-Aryans*, Vol. II, pp. 267—74. Also *Manu* 10.44. The Khasas have been mentioned by Varâhamihira in *Brihat Samhitâ* (6th Cent. A.D.)

[3] Sukra I, 205-6. [4] Sukra III, 372-74. [5] Sukra I, 425-28

Sukrâchâryya :—"The wall (of the Capital city) should have many strong shrubs and have a system of well-built windows, *and if a hill is not hard by,*[1] should have a *pratiprâkâra* or a second wall but less than itself in height."

Among the various fortresses mentioned in Section vi of Chapter IV there are *giridurgas*[2] or hill-forts which are described as being on high level and well-supplied with water. These forts[3] are known to be the best of all in point of military efficiency as presenting the greatest amount of difficulties to enemies. Thus "the fort that is protected by ditches only is the lowest of all, and the hill-fort is the best."

It is not probable that the regions for which this *Nitisâstra* is intended are mountainous or rocky in any special degree. The hills do not seem to have been the characteristic features of the lands, though they have been mentioned as some of the objects with which people become familiar through travel. "Through travel the numerous religious customs, materials, animals, races of men, hills,[4] etc. come within the cognisance of man."

(b) Rivers.

The country of the poets of the Sukra cycle is not only a land of hills but it is also a land of rivers. The suggestion that the capital should be built at a place that is bestirred by the movements of boats[5] indicates the importance given to rivers by Sukra in his description of an ideal economico-political organisation. That the authors were very familiar with rivers would be evident from the political application that naturally suggested itself to them in the matter of diplomatic relations. Thus in advising rulers to bow down to powerful enemies Sukrâchâryya illustrates his point by the mention of the fact that the 'cloud never moves against the current of the wind' and that 'the rivers[6] never leave the downward course.' A common natural phenomenon has been here pressed into service to explain what in terms of modern statesmanship would be called 'moving along the line of least resistance.' So also in advising the king to restrain passions and try cases or administer *Vyavahâras* according to *Dharma*, the author mentions that the subjects follow the king who does this, "as the rivers the ocean."[7] The fact that Sukrâchâryya has to lay down the humane rule that if a "bound-down" or *âsiddha* person[8] violates the limitations imposed upon him when swimming a river, &c., he is not guilty (and should not be punished) is also an evidence in point." The rule that "anybody who can save somebody's wealth from absolute destruction owing to the ravages of water or deluge[9], (from rivers, &c.) has right to one-tenth" points to the same adaptation of juristic ideas to the physical features of the country.

Rivers are no negligible features in the topography of the country for which Sukrâchâryya's code has been designed. The fact that rivers[10] are very

[1] Sukra I, 478-9.
[2] Sukra IV, vi, 8-9.
[3] Sukra IV, vi, 11-12.
[4] Sukra III, 262-63.
[5] Sukra I, 425-28.
[6] Sukra IV, vii, 492.
[7] Sukra IV, v, 210-211.
[8] Sukra IV, v, 564-64.
[9] Sukra IV, v, 601-2.
[10] Sukra III, 283-284, "one should not trust the abodes (beds or channels) of rivers."

changeful and constantly shift their beds was well-known. And the advice[1] that one should not cross the rivers by arms or get into a boat that is likely to give way, indicates the familiarity of the authors with rivers. These are to be wisely used in the interests of the state's commerce. Means must be adopted to make them highways of water-traffic, as also the impediments presented by them to land-communication must be removed. That rivers should not be allowed to remain barriers to intercourse, as naturally they are, is sufficiently suggested in the following advice: "Bridges should be constructed over rivers.[2] There should also be boats and water-conveyances for crossing the rivers." "Roads are to be povided with bridges."[3]

But rivers have been mentioned in *Sukraniti* specially in connexion with agriculture and land-revenue, and the inferences that can be made from accounts of the natural resources of the state do also point to the importance of rivers as sources of the country's national wealth. The observation of Herodotus that 'Egypt is the gift of the Nile' is in the Hindu sage's language expressed by saying that the lands are the 'daughters' of rivers, or rivers are the 'mothers' of soils. But rivers are not the sole irrigators of lands, there are other mothers of lands also *e.g.*, rains, tanks, wells, &c. In the assessment of lands the ruler is advised to make a distinction between land and land on the basis of the nature of the source of water-supply. Thus "the king should realise one-third, one-fourth, or one-half from places which are irrigated by tanks, canals and wells, by rains and by rivers respectively." The equity of this diversity of assessment lies in the fact that where rivers are irrigators the cultivation is certain, and hence the Government demand is heaviest. But Sukrâchâryya is also aware of the fact that, though rivers are superior to all other sources of irrigation in point of certainty, the moisture yielded by them, however, is not copious,—and do in fact yield the palm to clouds which, though precarious and uncertain, give abundant water when they do pour down their contents. The difference between rivers and clouds is like that between ordinary well-to-do men and sovereigns in the matter of riches. And the analogy that naturally suggests itself is expressed in the following lines: "Can the nourishment that is due to the rain-water from clouds be derived from the water of rivers[4] &c.? So also the promotion of the people's weal depends on the property of the king. Can this accrue from the wealth of the rich folk?"

From the above account of rivers[5] it would have been sufficiently clear that the authors of the Sukra cycle were well-acquainted with the importance of rivers in Politics, Commerce, Agriculture and Public Finance, and that the general aspect of the country is that of a plain intersected by rivers rather than that of rugged mountainous defiles and precipices.

[1] Sukra III, 52-53. [2] Sukra IV, iv, 125-129. [3] Sukra I, 35.

[4] Sukra IV, ii, 227-229, cf. also Chapter III, 552-554. "Agriculture which is said to have rivers for mothers is a good occupation."

[5] Sukra V, 14-16.

(c) *Seas.*

Coming now to the hydrosphere of Sukrâchâryya's country we find that the sea is a familiar sight with the poets of the Sukra cycle. The connexion between the moon and the sea is too well-known to all Hindu poets. In describing or defining the seven constituent elements of a state Sukrâchâryya characterises the first element, the sovereign, as by nature or by connotation of the term the person who is the cause of the prosperity of this world, is respected by the experienced and old people and gives pleasure to the eyes (of the people) as the moon to the sea."[1]

A phenomenon connected with the sea which appears to have been very familiar with the poets or at least known to them by hearsay, *viz.*, the maritime navigation by boats, is very naturally pressed into service by the poet in describing the evils resulting from the imperfections of the ruler. Thus we read that "if the king is not a perfect guide his subjects will get into trouble as a boat without the helmsman sinks in a sea."[2] The comparison of the king with a *karṇadhâra*[3] or helmsman piloting the 'ship of the state' is very suggestive. Nor is this all. The importance of sea and maritime commerce is adequately recognised by the statesmen of the Sukra cycle in the plan they have framed for the site and structure of the Capital city. It is to be situated at a place which, like the 'city of the seven hills' in ancient Italy, is to be near, but yet distant from, the sea.

Pliny ascribed much of the importance of Rome to this condition. We find Sukrâchâryya also suggesting that the spot is to be "bestirred by the movements of boats up to the seas." The capital is to enjoy the advantages of both rivers and seas. Communication with the sea has thus been recognised as an integral factor of the state's commercial wealth. It is also an element of the sovereign's political importance and dignity. The ambition of swaying the destiny of an empire from sea to sea or ruling the world encircled by the ocean has always fired the enthusiasm of Hindu kings and statesmen as would be evident from even a superficial study of Sanskrit literature as well as the inscriptions[4] on copper-plates and other materials describing gifts of lands, &c., to worthy persons or to the gods by sovereigns and ministers.[5]

Flatterers and sycophants as well as court-poets when applauding the merits of their protectors never stop short of the reference to the seas as the natural boundaries of their conquered territories. This ideal of having an

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[1] Sukra I, 127-28.

[2] Sukra I, 129-30.

[3] The mention of *nâvikas*, boatmen or sailors, in connexion with the various crafts or industries to be maintained by the King (II, 404-5) also points to the importance of rivers and seas in the topography of *Sukranîti*.

[4] Sukra I, 425-28.

[5] Mr. Aiyangar's *Ancient India* contains various accounts of the maritime importance of the Chola Empire and Kingdoms in South India; and Mr. Akshay Kumar Maitra's *Gaudalekhamâlâ* or the Manual of the Inscriptions of the Pâlas and Sens of Bengal gives numerous evidences of the natural ambition of rulers to be master of the seas.

empire bounded only by the sea is also present in the imagination of Sukrâchâryya, who, in urging the necessity of moral education of princes, sets before them this laudable mission of their lives as a sufficient spur to their self-culture. Thus, "how can the man who is unable to subdue one's mind master the world extending to the sea?"[1] Verily, the sea is the natural limit of one's ambition—the "scientific frontier" of Indian Napoleons.

An indirect knowledge of the sea and its inmates is suggested in the lines which advise people always to be humble and modest. Thus "the wise man should never consider 'I am superior to all, I am more learned than others,' for one should remember that there is the animal which devours the devourer of whales,[2] *Râghava* is the devourer of that even, and there is the destroyer of *Râghava*." The whale is certainly a sea-animal, and the mammoth fish *Râghava* is a monstrous marine creature celebrated in Hindu folk-lore.

Among the islands of the sea we have found that *Sinhala* or Ceylon has been mentioned definitely by name as the place where people can make artificial pearls. References to islands are to be met with only in two other places in this treatise. Thus in describing the grades of rulers in the order of their revenue Sukrâchâryya mentions the highest as the *Sârvabhauma*[3] or the paramount sovereign to be the ruler whose income, calculated according to modern Indian monetary standards, would exceed Rs. 416,666,666, and "to whom the earth with its *seven islands* is ever bound." The second mention of islands is in connexion with the punishment of offenders. "Persons who are wicked by nature should be expelled from the commonwealth and bound and transported to islands."[4] The use of islands as convict settlements is unmistakably suggested here.

From the foregoing description of general physical features of the country as are suggested by casual references or "internal evidences," it is not at all possible to make any definite inference as to the exact *locale* or surroundings in the midst of which *Sukranîti* might have been composed. The accounts are all of a very general character and cannot be traced to any special sets of geographical influences. It is, however, certain that the country does not present a dull monotony or uniformity of physical aspects, both in lithosphere and hydrosphere.

SECTION 4.

Climate and Soils.

The same diversity and variety of natural facts and phenomena of the land of Sukrâchâryya would also be clear from an analysis of the other aspects of its physiography, *e.g.*, its meteorology, geology and vegetation.

I. Meteorology.

Though *Sukranîti* is not a text-book of physical geography, the varied atmospherical and climatological conditions of the country familiar to the authors

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[1] Sukra I, 107-108.
[2] Sukra I, 368-74.
[3] Sukra III, 446-447.
[4] Sukra IV, 215-216.

can be gathered from various duties prescribed to kings and people as well as from the description of customs and rites during the several periods of the year and from the metaphors or similes occasionally used in elucidating or illustrating the ideas.

Heavenly Bodies

The sovereign is the lord of both "movable and immovable worlds;"[1] and among the thirty-two *vidyâs* or sciences there is the mention of *Jyotiṣa* as one of the six *Vedângas* or branches of learning auxiliary to the study of the Vedas. It is the science which "measures time by studying the movements of *nakṣatras* (stars) and *grahas*[2] (planets)" and the aid of other sciences. Besides, it is said that the movements, shape and nature of the *nakṣatras*[3] (stars) are one of the factors in the division of time into epochs or periods. In all these instances it is evident that Sukrâchâryya displays a knowledge of the heavenly bodies, both planetary and fixed, and is acquainted with the facts of their movements and their effects on time.

Some of these heavenly bodies have a double character—first, as members of the Solar System governing the conditions of time, season, &c., as noticed above, and, secondly, as apotheosised into divine beings and made rulers of certain directions of the Universe. The sun and the moon are two such gods in Hindu mythology, and Sukrâchâryya mentions that the sovereign, besides being made out of the permanent elements of other gods,[4] *e.g.*, Indra, Vâyu, Yama, Fire, Varuṇa and Kuvera (who are the lords of six specified regions marked out by six points of the compass), has in him the attributes of the sun and the moon also. Thus "just as the moon pleases human beings by its rays, so also the king satisfies everybody by his virtues and activities." Also, "as the sun is the dispeller of darkness (and the creator of light), so the king is the founder of religion and destroyer of irreligion."

Besides the above comparison of the king with the heavenly bodies which is a common device in all *Nîtisâstras*, the poets of the Sukra cycle have displayed another popular fancy about the orbs of the celestial world. The nine *Mahâratnas* or great gems mentioned in *Sukranîti* have each a deity presiding over it. These deities have to be satisfied by people by putting on the gem that is favourite to each. These deities are the *navagraha*[5] or nine planets of the heavenly firmament, *viz.*, the Sun, the Moon, the Mars, the Mercury, the Jupiter, the Venus, the Saturn, the Râhu and the Ketu. The subject will be treated at length in the chapter on precious stones and metals. It may be mentioned here, in passing, that the colour attributed to these deities apotheosised out of the heavenly bodies, the *navagraha*, in the propitiatory hymns addressed to them exactly corresponds with the colour and lustre of the *Mahâratnas*,—*vajra*, *muktâ*, *pravâla*, *gomeda*, *indranila*, *vaiduryya*, *puṣyarâga*, *pâchi* and *mâṇikya* which are supposed to be the favourites of those beings respectively.

[1] Sukra I, 141-148.
[2] Sukra I, 41-42.
[3] Sukra IV, iii. 88-89.
[4] Sukra I, 14-1151.
[5] Sukra IV, ii, 84.

The Sun.

The Sun has been already referred to as having something to do with Time in its capacity as a member of the Solar System. Its second character is that of a deity who gives light, whose attributes the king possesses. Its third character is that of one of the *navagrahas*, in which capacity it is to be propitiated by people by the use of the *mâṇikya*[1] or ruby, "which has red colour and the bright lustre of the Indragopa insect."

Besides these super-terrestrial references, the mundane phenomena of the Sun as the "dispeller of darkness"[2] and the source of heat have also been mentioned in *Sukranîti*. Among the general rules of life it is stated that one should not always look to the Sun (III, 61). Sukrâchâryya compares the companionship of wicked characters to the rays of the burning Sun: "One should abandon the company of bad men which is terrible like the desert scorched by the summer Sun,[3] frightening and inhospitable." The Sun's rays, however, are not all terrible, they are of varying degrees. So it is only towards enemies that the king should display his character of the "summer Sun."[4] But towards his own people he should present the milder front of the "Spring Sun."[5]

As to the division of time noted above it is mentioned that there are three systems of temporal measurements. "Time is divided according to three systems—solar movement,[6] lunar movement (period from full moon to full moon, *i.e.*, two fortnights) and according to Savana (period from morning to morning, *i.e.*, 24 hours)." These three[7] systems do not yield equal results, the solar day being longer than the lunar; and so it is suggested that "in making payments of wages one should always take the solar[8] time, in augmenting interest, the lunar time."

The Moon.

The Moon, also, like the sun, has three-fold characteristics: (1) those of a member of the solar system governing time, seasons, &c., (2) those of a deity who gives pleasure, whose attributes the king possesses, and (3) those of the apotheosised celestial being who has to be propitiated by people by the use of its favourite gem, *viz.*, *muktâ*[9] "which is of red, yellow, white and *śyâma* (greenish blue) colour."

In *Sukranîti*, the sun and the moon have been mentioned very often together:[10] and this not only with reference to the super-mundane affairs as

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[1] Sukra IV, ii, 84-92.
[2] Sukra I, 146.
[3] Sura I, 325-26.
[4] Sukra II, 560-67.
[5] Sukra II, 566-67.
[6] Sukra II, 788-789.
[7] Sukra II, 789-790.
[8] Sukra IV, ii 85.

[9] Prof. Yogeśa Chandra Ray has treated the subject very elaborately in his schola y work in Bengali on The *Astronomy and Astronomers of the Hindus*.

[10] In describing feathers and hairy rings called *bhramas* on the horse's body Sukra says that two such marks on the forehead with space between indicate good and are like theSun and the Moon. (IV, vii, 206-207).

noticed above, but also in the matter of secular references. Thus, if the influence of bad men is like that of the burning sun, that of good people is like that of the moon. "The man who is attended by good men gratifies the heart in the same way as the moon[1] with its cool rays pleases the tank with its newly blossomed lotuses." This parallelism is carried forward to the elucidation of the various attitudes the king should have. Thus, if he should be the summer Sun to enemies, and the spring Sun to his own people, he should bear the attitude of the autumn Moon to the learned people. The autumn is the season after the rains, hence very clear and generally cloudless; and the moon would then shine in all its glory. The king who has this attitude must have the most pleasant bent of mind; and this is what should be his mood towards the learned people. But the sun in spring season is hot enough, though milder than the summer sun; and this blending of mildness with severity should characterise his relations with the subjects, whereas he is to be solely severe and terrible towards the enemies. Again, as mentioned above, not only the sun, but also the moon governs the time. Among the three systems of temporal measurements[3] one is that of the division of time according to lunar movement, and this is to be adopted when the object is to augment the interest.

In Indian literature, generally, the moon plays an exceptionally conspicuous part. The poets of the Sukra cycle also have given indications of this partiality in their composition. We meet with references to the moon alone over and above the parallelism or antithesis between itself and the sun, as detailed above. Thus, it was mentioned in connexion with the sea that "the king is the cause of prosperity of this world, &c., and gives pleasure to the eyes of the people as the moon to the sea." Then again, in enumerating the divine parts or attributes of the sovereign, Sukra asserts that he should possess all the qualities of the eight gods. Otherwise, he is a mediocre. "As the moon[?] does not shine well if deprived of one of its parts, so the king does not flourish unless he has all the parts described above."[5] The moon is thus beautiful and splendid only when it is full. But there are beauties and beauties; so the beauty of the moon, when deprived of some of its parts, say a quarter or a half or even seven-eighths,[6] is not insignificant. The shape of the half moon is a beautiful sight to the poets of the Sukra cycle, who have suggested that "the capital should have the beautiful shape of the half moon[7] or circle or square." The moon in Indian literature is not only a standard of beauty, but is also a common object-lesson of gradual growth. Thus the crown-prince is "to grow slowly like the portion of the moon[8] in the bright fortnight." There is another convention with Hindu poets regarding the parts of the moon. If the waxing of the moon in parts through a whole fortnight supplies the analogy for the development of adolescence in infants, especially

[1] Sukra I, 323-324.
[2] Sukra II, 560-567.
[3] The Astronomical knowledge of the poets of the Sukra cycle will be dealt with in a subsequent chapter.
[4] Sukra I, 127-128.
[5] Sukra I, 152.
[6] Sukra I, 429-430.
[7] Sukra II, 101.
[8] Sukra III, 432-433.

princes and princesses, the waning or the gradual reduction of its parts throughout the dark fortnight supplies the stock-in-trade for comparison with the giving away of wealth and property in charity. In the chapter on general rules of morality for the people, Sukrâchâryya thus describes the effects of gifts: "In this world there is nothing more capable of subduing others than charity and simplicity. The moon[1] that has waned through gifts, when waxing, is beautiful, though in the form of a curve." Here we have both the beauty of the curve and the comparison of giving away with waning in the same line. It has to be noted, moreover, that shape is only one of the elements in the beauty of the moon. The other element is lustre. Sukrâchâryya mentions it when describing a weapon of war, *e.g.*, the "*Kṣuraprânta* which is high to the navel, has a strong fist and the lustre[2] of the moon."

The Atmosphere.

We have seen above that the ambition of paramount sovereigns in India was never restricted to the lithosphere and that in quest of victory they must reach and govern the hydrosphere also. The glory of swaying even the atmosphere is, likewise, another touchstone of monarchical sovereignty. With Hindu poets it is a common device in extolling their heroes to cry them up to the skies, both literally and figuratively. The man or sovereign whose fame does not reach the skies is not a famous person indeed. Kâlidâsa in introducing the rulers of the solar dynasty to the readers of his celebrated *Raghuvamsam* mentions their mastery of the three worlds, the land, the water and the aerial regions in one short line, *âsamudra-kṣitiśânâm ânâkarathavartmanâm* (*i.e.*, his heroes were rulers whose sway included the earth and the sea and whose chariots used to traverse the highways of the sky).

Sukrâchâryya, therefore, in order to make his precepts of discipline and self-control palatable to the princes, does not forget to give them a sugar-coating by mentioning the glorious and enviable results of practising them in life. Thus, "of the monarch who has conquered his senses, and who follows the Nitisâstra, prosperity is in the ascendant and fame reaches the skies."[3]

There is another reference to the sky in *Sukranîti*. This is in connexion with the adoption of proper policies and methods of work with regard to friends and foes. "By appropriate means the terrestrial beings can soar into the sky[4] and even the thunder can be pierced." The efficacy of human intelligence is here illustrated by allusion probably to the air-chariots of ancient times, called *Vimânas* or *Puṣpakarathas* which have had a strong hold on Hindu popular tradition. Such an air-chariot piercing the thunder, *i.e.*, going beyond the region of clouds, &c., and traversing the whole distance of India from Ceylon in the South to Ayodhyâ in Upper India has been immortalised by Kâlidâsa in the 13th canto of *Raghuvamsam.*

[1] Sukra III, 432-433.
[2] Sukra IV, vii, 427.
[3] Sukra I, 301-302.
[4] Sukra IV, 50.

The Air or Vâyu has been mentioned as one of the eight gods whose attributes the king possesses. Its function is propagation or diffusion. Thus "as Vâyu[1] is the spreader (and diffuser) of scents, so is the king the generator (and cause) of good and evil actions." The current of the air has been suggested in the line which advises the king to move along the line of least resistance, just as "clouds do not move against the wind." The poets of the Sukra cycle have also mentioned the air as the friend of fire in order to draw the moral that Right always should follow Might and that morality does not flourish where there is no strength. The precept is given in the following lines : "One should follow *niti* or the moral rules so long as one is powerful. People remain friends till then ; just as the wind[2] is the friend of the burning fire." A common phenomenon regarding the air has also been recorded : "It is possible to protect the lamp with its wick and oil from the wind[3] with great care."

The Clouds.

Clouds and rains have been often referred to in *Sukranîti*, as we have seen above in connexion with rivers. Rains[4] are some of the physical factors in the division of time into periods or epochs. The analogy by which the poets of the Sukra cycle illustrate the advantages of punctuality, regularity and keeping to time generally, indicates the very important place rains occupy in the physical and economic conditions of the people among whom they lived. The work done at the time appointed for it is certain to produce good results. Thus rains[5] in time give rise to plenty, but otherwise are highly injurious. In India, the land of monsoons, where people depend on the rains for cultivation, uncertainty and precariousness of the rainy season mean famine and ruin. This observation of the author, therefore, is certainly to be attributed to one of the predominant features of the physical environment. The same idea has been repeated in section I of Chapter IV : "Where the clouds do not pour rain[6] in season, there the lands are not productive and the commonwealth deteriorates, &c."

The lands that are irrigated by clouds pouring their contents upon them are said to be *devamâtrika, i.e.*, to have the gods or natural agencies, *e.g.*, Indra the cloud-god, for their parent ; just as lands watered by rivers are known to be *nadîmâtrika, i.e.*, to have them as their mothers.

We have noticed previously that Sukrâchâryya's Land-Revenue-Policy is equitable and elastic. Thus, where rain is the source of moisture, agriculture is precarious and uncertain, since the monsoons do often fail. Hence, the demand of the Government is to be very small compared with that from lands irrigated otherwise. "The king should realise one-third, one-fourth or one-half from places which are irrigated by tanks, canals and wells, by rains[7] and

1 Sukra I, 145.
2 Sukra IV, vii, 376-377.
3 Sukra I, 41-42.
4 Sukra I, 573-574.
5 Sukra I, 106.
6 Sukra IV, i, 122-123.
7 Sukra IV, ii, 227-220.

by rivers respectively." It has also been noticed above in connexion with rivers that, though rivers are certain when compared with rains, they cannot however yield the plenty that nature does. Thus "can the nourishment that is due to rain-water from clouds[1] be derived from the water of rivers?"

There are two other references to clouds in *Sukranîti*, one is about their colour. The *Mahâratna Indranila* which is Saturn's favourite, has the "colour of black clouds."[2] The other reference mentions them as the source or mother of pearls.[3] This will be discussed in a subsequent chapter.

The Seasons.[4]

The foregoing accounts of the country of the poets of the Sukra cycle leave no doubt that, generally speaking, it is (1) a land of the powerful sun and (2) a land of rains. It is thus both hot and moist.

It is a noteworthy fact that there is no reference to extreme cold throughout the whole treatise, though there often occurs the idea of extreme heat. All the six Indian seasons of two months each have been mentioned in the treatise; and their explanation has been given to be the influence of temperature (*i.e.*, hot and cold) and moisture (*i.e.*, dry and wet). Sukrâcharyya divides Time in two ways: (1) Social or human, *i.e.*, historical, according to the events and movements in man's social life, *e.g.*, the age of Asoka, the epoch of the Reformation, &c., and (2) Physical, according to (*a*) the seasons and (*b*) the rotations and revolutions in the solar system which bring in days, nights, months, years. We have already alluded to the influence of the "movements, shape and nature of the planets" in connexion with the heavenly bodies. Here we shall point out the references in *Sukranîti* to the weather and seasons affecting the country's climate as determined by heat[5] and cold as well as drought and moisture.

The summer[6] which presents the sun scorching the desert has been already noticed; and we have also found that the king should present the front of the summer sun[7] towards the enemies. The summer being a terribly hot season, Sukra's advice to horsemen and jockeys of the Cavalry Department is that they should ride the horse[8] in the evening during that period, and to gardeners[9] that they should water the plants twice a day in the morning and evening. Again, as for the seasons of warfare, the "summer[10] is the worst." In India the summer is technically known to be the period of two months from the middle of April to the middle of June.

The rainy season extends from the middle of June, when the monsoon generally sets in to the middle of August. We have already noticed the

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[1] Sukra V, 14-15. [2] Sukra IV, ii, 90. [3] Sukra IV, ii, 117-118.

[4] See the summary of Kâlidâsa's *Ritusamhâra* or 'Cycle of Seasons' in Macdonell's *History of Sans. Literature*, p. 337.

[5] Sukra I, 41-42.

[6] Surka I, 325-320.

[7] Sukra II, 566-567.

[8] Sukra IV, vii, 266-267.

[9] Sukra IV, iv, 105-106.

[10] Sukra IV, vii, 446-448.

importance given by the poets of the Sukra cycle to the regularity or punctuality of the rains, also the place they occupy in the economy of nature from a calculation of which equitable assessments of Land Revenue are to be made. In the rainy season horses require to be carefully treated, and Sukra's positive advice to horsemen[1] is not to use them during that period. It is not a good season for the use of carriages,[2] cars or chariots. Nor is it a convenient time for warfare. "In the rainy season[3] war is not at all appreciated, peace is desirable then." But it is very convenient for gardeners and agriculturists who are advised never to water the plants[4] during this period.

The Indian Seasons have played a great part in the history of Indian warfares. The monsoons which give rise to tempests and heavy downpours, swollen rivers, and malarial swamps have decided the issue of many battles and sieges in Eastern India. Relativity of politics to geographical environment is nowhere better illustrated than in the influence of the rains and rivers in Bengal and Assam. Can this, however, point indirectly to the locale or surroundings of the poets of the Sukra cycle ?

The autumn is a delightful season in India, generally cloudless, or rather with deceptive invisible clouds, extending from the middle of August to the middle of October. The autumn moon is celebrated in Indian poetry, because its lustre is then gloriously set off against the background of a pure blue sky. We have seen that Sukrâchâryya, in advising the sovereign to put on his most agreeable attitude when he has to receive learned men, asks him to be like the autumn moon. As for riders, they are enjoined to use the horse[5] in the morning in this season. The autumn is also one of the best seasons[6] for warfare.

hTe *Hemanta* is the season which forebodes the advent of winter. It extends from the middle of October to the middle of December. There are only two references to *Hemanta* in *Sukranîti*, both in connexion with military affairs. The *Hemanta*,[7] being a mild season, of decaying heat and increasing cold, horses may be used both in the morning and evening. It is also, like autumn, one of the best seasons for warfare.[8]

The winter is the next two months and has been mentioned in connexion with the riding of horses and also as a season for warfare. As in the preceding season, horses may be used both in the morning and evening in winter. It is likewise the most convenient period of the year for military operations. It is also enjoined that gardeners need not water the plants every day in winter;[9] they should do this every alternate day. As we have said above, the Sukra poets have dilated on the summer and its effects, but about the cold and the effects of winter generally they are very reticent. There is a mention of *hima* as one of the agencies that may injuriously attack the grains of the fields. But it is not clear what the purport seems to be. It may mean both dews and

[1] Sukra IV, vii, 268.
[2] Sukra IV, vii, 352-353.
[3] Sukra IV, vii, 446-448.
[4] Sukra IV, iv, 105-106.
[5] Sukra IV, vii, 260-267.
[6] Sukra IV, vii, 446-448.
[7] Sukra IV, vii, 206-207.
[8] Sukra IV, vii, 446-448.
[9] Sukra IV, iii, 50-57.

snows. The king has been advised to preserve in a store-house against future calamities such "grains as have not been attacked by poisons, fire or snows[1] (dews ?) or eaten by worms and insects, &c."

There may be a presumption that the summer being the principal season of the area within which the poets lived has left its influence upon their work; while the winter there being only one of the six seasons, and of no considerable inclemency, has been but scantily noticed and has had a very subsidiary effect on the poets' thought and life. If anything can be argued from the negative, it may be mentioned, as we have had reasons to state above, that the country of the poets of the Sukra cycle is a land pre-eminently of the summer and the rainy seasons.

The last Indian season is the Spring extending from the middle of February to the middle of April. It is the season *par excellence* of Hindu poets, the period of the hegemony of Madana, the Cupid of Hindu mythology. But the poets of the Sukra cycle are too prosaic statesmen and diplomats to be swayed by the conventions of orthodox poetical style. In fact, the whole work of Sukrâcharyya bears throughout the character of a serious matter-of-fact treatise on the most momentous problems of human life; and the authors have systematically and consistently maintained their dignity by not indulging in a single superfluous epithet or unnecessary descriptions and digressions in the interest of rhetoric, word-painting or the like; though no doubt the arrangement is occasionally diffuse and inconsequential, as in the works of Adam Smith and Montesquieu. *Sukraniti* is the last work to be handled for specimens of literary grace or embellishments. This is unfortunately one of the many reasons which prevent it from being characterised as the work of a certain epoch of literary history. Its style is that of solid scientific Sanskrit and cannot be easily put into one of the classes of ordinary poetry in Sanskrit literature. This will be elaborately discussed in a subsequent chapter.

There are four references to the spring in *Sukranîti*. The first is that in which the king is advised to be like the spring-sun, *i.e.*, neither too mild nor too severe, in the treatment of his own people. The second is in connexion with the use of horses. As in the Hemanta and winter, one should ride the horse both in the morning and evening in the spring season.[1] The third reference describes it as a good season[2] for warfare, better than the rains and the summer, but worse than the autumn, Hemanta and winter. The fourth mention of the spring is in connexion with the watering of plants during this period. This is advised to be done in the fifth part of the day, *i.e.*, in the afternoon.

II. Geology.

As could be inferred from the accounts given above, the country of Sukrâcharyya is mainly agricultural. From the diverse references to the occupations of the people it would be apparent that the soil is one which is fit for pasture and agriculture. And from the frequent mention of grasses, woods, forests

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[1] Sukra IV, iii, 50-57.   [2] Sukra IV, iv, 105-106.

and other signs of rank luxuriant vegetable growth, also, one could easily infer that the crust of the earth is made up of damp alluvial soil. But the poets of the Sukra Cycle know of other regions besides these fertile plains. They mention deserts scorched by the summer sun, as we have noticed above. Among fortresses[1] there are those in deserts also, and these are superior to the forts which are surrounded on all sides by ditches only. Then there are the "barren and rocky soils"[2] from which, according to the humane legislation of Sukrâchâryya, the king should realise only one-sixth as Government Revenue, as opposed to one-half from lands irrigated by rivers. Sukra mentions "uneven"[3] grounds also, and advises the horsemen to take special care in, or rather refrain from, using those regions. It is not clear, however, what is meant by 'uneven' lands. There may be a reference to ordinary undulations as are to be met with often in plains, or even to hilly tracts which are uneven wholesale.

The treatise of Sukrâchâryya contains several references to the earth underground. That the earth carries in its womb precious metals is a common-place idea in Hindu literature. Possession of wealth is, in fact, an attribute of the earth. Sukrâchâryya also says: "The man who is powerful, intelligent and valorous enjoys the earth[4] full of its wealth." This is Sukra's version of the idea contained in the adage *Virabhogyâ Vasundharâ* (the *Vasundharâ*, the earth, which bears wealth can be enjoyed by the heroes alone). 'Mines'[5] have been often mentioned as one of the sources of Government Revenue. The section on Treasure gives details about precious stones, metals and other mineral products.[6] This will be treated fully in the next chapter—*The Data of Ancient Indian Mineralogy.*

The mention of sulphur[7] and *Suvarchi* salt (Saltpetre) in connection with the preparation of gunpowder may, however, be noted here.

SECTION 5.

Flora and Fauna.

We have found the country described in *Sukraniti* to be a land of diverse natural and physical features. Its wealth of mineral resources has also been hinted at in the last section. Nor is the land poor in its vegetable and animal denizens. The poets of the Sukra Cycle have nothing to do directly with plants, trees and shrubs or with birds, fishes and mammals. It is only in a subsidiary or auxiliary capacity, *e.g.*, as bearing on the social, economic and

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[1] Sukra IV, vi, 2, 11-12. [3] Sukra IV, vii, 208.
[2] Sukra IV, ii, 230. [4] Sukra I, 340-50.
[5] Sukra II, 211-212, 671-672 ; IV, ii, 213.

[6] These and allied subjects have been dealt with in the Bengali works on Gems by Prof. Yoges Chandra Ray and Dr. Ramdas Sen as well as in that valuable exposition of Hindu Culture in some of its secular aspects, *The History of Hindu Chemistry*, by Dr. P. C. Ray.

[7] Sukra IV, vii, 400-404.

political life of man, that these creatures of the lower living world have any place in the treatise of Sukrâchâryya. But even then the authors have displayed a good deal of knowledge about the habits, habitats, food, diseases and structure or external characteristics of the plants and animals, as well as the uses to which they are put by man for the furtherance of his ends of life. We shall form an estimate of the Botanical and Zoological knowledge of these authors of the Sukra Cycle in subsequent chapters. This, together with an account of the mineral products of the country, would give an Economic Geography (as well as History) of India in ancient and mediæval times. In this section we propose to give only the names of the plants and animals occurring in *Sukranîti*.

I. PLANTS.

Grasses and woods have been mentioned several times. Among the functions of the Sudras one is that of carrying wood and grass.[1] The Capital should be situated at a place that abounds in trees and shrubs and plants, is endowed with good supplies of grain and is happily provided with resources in grasses and woods. There is an injunction that the wall of the capital city should have many strong shrubs.[3] Among the persons to be expelled from the commonwealth like "sturdy vagabonds" are people "who live on alms even though they are capable of collecting wood and grasses."[4] Men who collect grasses and woods[5] have to pay revenue to the state to the extent of one-third, one-fifth, one-seventh, one-tenth, or one-twentieth.

Vast forests[6] where elephants run to and fro have been mentioned figuratively in connexion with the moral training of the sovereign. "In a forest[7] of six *yojanas* (*i.e.*, forty-eight miles) the best *Râjamârga* is to be constructed; in the middle, the average, and between the two the worst." So the Forest-Administration of the State has provision for roads in extensive woody lands. Forests[8] are rich in wild games which are to be killed by kings in their hunting excursions that should be regular features of their lives. The forests are administered by a special officer[9] well up in agri-flori-horti-arbori-culture, as we should say in modern times. Solitary forests should not be frequented or even visited by people. This is one of the general rules of morality. The man who has a bad wife or who has to live on alms has been advised to "prefer life in a forest."[10] Forests are the places where wild trees should be planted. Among forest-produce there is the mention of honey.

Creepers have been mentioned only once. "Pandits, females and creepers[11], do not flourish without resting grounds." The causes of the development of flowers[12] and fruits are known to the superintendent of parks and forests. Three of the sixty-four *kalâs* or arts are the planting, grafting and preservation

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[1] Sukra I, 85-86.
[2] Sukra I, 425-428.
[3] Sukra I. 478-479.
[4] Sukra IV, i, 209-210.
[5] Sukra IV, ii, 237-238.
[6] Sukra I, 193-194.
[7] Sukra I, 528-529.
[8] Sukra I, 665-666.
[9] Sukra, II, 317-319.
[10] Sukra III, 576-577.
[11] Sukra I, 767.
[12] Sukra II, 317-319.

of plants, the use of preparations from sugar-canes[1] and the knowledge of the mixtures of metals and medicinal plants. Every root is supposed to have medicinal properties (II, 254-255).

Sukrâchâryya has divided trees into two classes, domestic and wild, and enumerated them in Section iv of Chapter IV. Besides these trees, several plants have been mentioned in *Sukranîti*, by name, which are being enumerated below: bamboos (IV, ii, 117-118; IV, iii, 190), lotus (I, 211-212), mustard (III, 619-620), betels (IV, iii, 198), paddy, tila, mâsa, mudga, yava (IV, iv, 107-108); peas, IV, vii, 285-286), cotton (IV, vii, 356-357), arka, snuhi, wheat (IV, vii, 432-33) and garlic (IV, vii, 400-404).

A careful study of the "habitats" or "Distribution" of these trees, plants and shrubs is likely to be of considerable help in determining the geography of the locality which produced the *Sukranîti*. This will be done in a subsequent chapter. The study of Plant-Geography with this object is more important than that of the distribution of minerals. For minerals, as commercial merchandise, may be transported easily from the localities which produce them, whereas plants are more or less stationary commodities which tell their own tale as to the soils, surroundings, etc.

2. Animals.

Facts of Zoo-Geography also, like those of Botanical Geography, can be gleaned from passages in *Sukranîti*. But the enumeration of the animals referred to in it, though no doubt it may point, to a certain extent, to the physical environment of the authors' lives, is less important in this respect than that of plants, since common domestic animals, *e.g.*, birds, etc., as well as those used in the Army may be brought from a distance as marketable commodities. This aspect of the question, together with the knowledge of Zoology displayed in the work, will be treated at some length in a forthcoming chapter. Here we shall simply enumerate the various animals mentioned in the work to give an idea of the diversity of the lower creatures that has left its impress on the work of the authors of the Sukra Cycle.

Snakes and tigers have been often mentioned, and in various connexions. Among the wild animals or "big games" of the forest we find lions[2] and bears.[3] The domestic animals are many, *e.g.*, cows, buffaloes, goats, cats, dogs, sheep, deer. The aquatic animals are the fishes, cowries (II, 712-713), conches (II, 402-403), whales,[4] Râghava,[4] crocodiles, tortoise (I, 531), oyster shells.[5] The Animal-corps consists of the horse, the elephant, bulls and camels. Among birds we have the cuckoo (I, 337-338), the peacock,[6] the drake (I. 337-338), the cock (I, 654-657), the parrot (II, 300-2), the crane (I, 654-657), the pigeon or dove, the partridge, the hawk (II, 300-21) and the *châsha* (IV, ii, 87). Besides these, there are monkeys (I, 654-657), boars,[7] ants (III, 20-22), worms (III, 20-22), flies (III, 33-34), bees (III, 33-34) and rats (I, 654-657).

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[1] Sukra IV, vii, 144-147.
[2] Sukra IV, i, 48-49; IV, iv, 331-334; II, 85-87.
[3] Sukra IV, vii, 380.
[4] Sukra III, 446-447.
[5] Sukra IV, ii, 117-118.
[6] Sukra I, 385-88; I, 665-668.
[7] Sukra III, 262-263.

CHAPTER III.

THE DATA OF ANCIENT INDIAN ETHNOLOGY.

SECTION 1.

Sukranîti as a source of Ethnological Information.

Having briefly surveyed the plants and lower animals in the preceding sections it now remains to point out the races or tribes of men mentioned in *Sukranîti* to complete the picture of Bio-geography that may be deduced from it. But the poets of the Sukra Cycle are very chary of any positive information regarding the various nationalities that lived in their time. *Sukranîti* is the last work in which one should search for ethnographical details about ancient India. We have seen also how poor the work is as a manual of ancient and mediæval Indian geographical names. This is all the more striking, since the work being purely socio-economic and socio-political is expected to be rich specially in the names of kingdoms, peoples, princes and cities. But as the matter stands, the authors fight shy of individual names and deal only with generalities. That the country was a land of diverse races, creeds and tongues as well as of diverse plants, animals, minerals and natural features is evident from the references to "other lands and peoples," "strange countries," "countries and languages," we have already discussed, as well as from the mention of the writing of the characters of the various languages as one of the sixty-four *kalâs* or arts. We have already noticed also that among the benefits of travel has been mentioned the pleasure of knowing the numerous religious customs, materials, *races of men*,[1] hills, etc. The caste divisions with their intermixtures and customs (both domestic and social) which the Sukra authors have described in detail will form the subject of a separate chapter. The intermixtures,[2] and *antyajas* that have been mentioned in the section on the *arts and sciences* refer to the castes and will be treated along with them. Here we propose to survey the few details about the races of men mentioned in the treatise.

SECTION 2.

The Races.

The following are the tribes mentioned in *Sukranîti*: (1) Yavanas, (2) Khaśas, (3) Mlechchas, (4) Purvadevas or Âsuras, (5) Râkṣasas, (6) Pisâchas, (7) Kirâtas, (8) Âryas.

Yavanas.

We have seen in a previous chapter that Yavanas, according to *Sukranîti*, "have all the four castes mixed[3] together. They recognise authority other than that of the Vedas and live in the north and west, their *sâstras* have been

[1] Sukra III, 262-263. [2] Sukra IV, iii, 22-23. [3] Sukra IV, iv, 74-77.

framed for their welfare by their own masters. But the rules that are followed for ordinary purposes are the same in the two cases." The purport is, that Yavanas differ from the children of the soil only in religion, but in matters of business, politics and the like there is no difference. The poets of the Sukra Cycle have mentioned *Yavanamata* or Yavanism as one of the thirty-two *vidyâs* or branches of learning. It is that philosophy which "recognises God as the invisible Creator of the Universe and recognises virtue and vice without reference to *Sruti* and *Smriti*, and which believes[1] that *Sruti* contains a separate religious system." It is thus the non-Vedic creed, or speaking generally, an alien or non-national faith.

Khaśas.

We have seen that the Khaśas have been mentioned only once. They are a people living in mountainous tracts to the south and west of the vale of Kâshmir. They are a people "who marry the widows of their brothers."[2]

Mlechchas.

Sukrâchâryya refers to Mlechchas five times. "Those who have deserted practising their own duties, who are unkind and troublesome to others, and who are very excitable, envious and foolish are Mlechchas."[3] The term has been used here metaphorically to connote certain undesirable, barbarous or alien characteristics rather than denote a race or tribe of men ethnologically or politically or even socially distinct from the ruling or predominant people. We find the term used in its literal sense as the name of a distinct race, caste or class of men in the following lines which describe the qualifications of persons from among whom recruits are to be drawn for the army as "officers" and "men." "Those who are well up in *Nîtisâstras*, the use of arms and ammunitions, manipulations of battle array and the art of management and discipline, who are not too young but of middle age, who are brave, self-controlled, able-bodied, always mindful of their own duties, devoted to their masters, and haters of enemies should be made commanders and soldiers whether they are Sudras, or Ksatriyas, Vaisyas or descended from Mlechchas."[4] These lines exclude only the Brâhmaṇas of the predominant or the Aryan race recognising the system of castes and stages, and allow all the other three castes to be enlisted in the army. They, however, mention a fourth class of men who may be likewise enrolled. They are evidently beyond the pale of Aryaism or Caste-and-stagism and certainly form a social polity by themselves.

This literal sense, however, is not observed, in the following lines. "The king who does not punish the false-speaking spy becomes the destroyer of the people's persons and properties and is called Mlechchha."[5] Here it is equivalent to an abuse or condemnation. The fourth reference in *Sukranîti* to the Mlechchas is in the literal sense of a race. This is in connexion with the Laws of Property.

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[1] Sukra IV, iii, 124-126.
[2] Sukra IV, v, 98.
[3] Sukra I, 87-88.
[4] Sukra II, 276-280.
[5] Sukra I, 675-676.

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"In the Sâstras sources of income as well as the castes are known to be various, and that Dharma of the Sâstras always binds even the Mlechchas."[1] According to the injunctions of Sukrâchâryya the Mlechchas also must abide by the regulations regarding title to property which are obeyed by the Brahmaṇas, Ksatriyas, Vaiśyas and Sudras, *i.e.*, the four castes of the Arya race. If the Mlechchas or whom the Greeks would have called "Barbarians," do not respect these laws, the community would be jeopardised, as is implied in the next line. "For the preservation of the community these have been fixed by previous sages." This is exactly what has been said about Yavanas[2] who, following their own apostles in matters of faith, must respect the civic laws of the state in which they live. The poets of the Sukra Cycle have displayed a pre-eminently modern conception by thus allowing freedom of religious convictions and practices but compelling obedience to one and the same system of non-religious laws throughout the realm. On the one hand, religious neutrality or toleration which implies a diversity of creeds, and on the other, uniformity or unity in economic, political and other secular interests,—these are the notions of the statesmen of the Sukra Cycle in the passages regarding the Yavanas as well as Mlechchas.

The literal sense of the term is to be noticed in the following lines where Mlechchas have been taken almost as a fifth caste or, at any rate, representing a class of men who do not fall within the fold of the four castes: "Not by birth are the Brâhmaṇa, Kṣatriya, Vaiśya, Sudra and Mlechcha[3] separated, but by virtues and works." Here, again, we have a very rationalistic interpretation of the Caste System, and this leads in the following lines to the use of the words, Brâhmaṇa, Kṣatriya, &c., almost in the metaphorical sense.

The Demi-gods.

Purvadevas[4] or Asuras are the disciples of the sage Sukrâchâryya. It is in the lectures of this Professor to his pupils that the present manual of socio-political science is said to have had its birth. The works of Plato and Aristotle in ancient Hellas had similar origins in the lectures to their pupils at the schools of the Academy and the Lyceum.

Vâtâpi is a king of the Asuras[5] mentioned by Sukrâchâryya to have been ruined through folly. Asuras have been mentioned as wicked beings or demons who attend the divine beings, the gods in the religious rites which are celebrated for them. They are in fact demigods, and their images have to be constructed along with those of the benign gods who destroy them. Sukra enjoins that "the images of Pisâchas and Asuras[6] are to be always sixteen *tâlas* (12 *angulas* make 1 *tâla*). Hiraṇyakasipu, Vritra, Hiraṇyâkṣa, Râvaṇa, Kumbhakarṇa, Namuchi, Nisumbha, Sumbha, Mahisâsura, Raktavija—these are to be sixteen *tâlas* in height." These are extraordinary dimensions, considering that the ordinary images of gods are to be not more than seven, eight, nine or ten *tâlas*

1 Sukra IV, v, 585-587.
2 Sukra IV, iv, 76-77.
3 Sukra I, 75-76, 77-88.
4 Sukra I, 1-3.
5 Sukra I, 287-290.
6 Sukra IV, iv, 179-182.

(or feet), and the normal is always the seven-tâla type for *Kali Yuga*. It is clear that Asuras here do not denote a race of human beings, but a class of demi-gods or supernatural creatures—the Titans of Hindu Mythology.

Râkṣasas are likewise a race of Titans, the enemies or rather rivals of gods, and have been mentioned in *Sukranîti* not so much as human beings as mythical giants. But as in the case of Asuras one of their kings has been mentioned along with other Paurâṇika kings and Rishis as instances of failure through vices. We read that "Râkṣasa[1] Paulastya was ruined through vanity." About the images of these Râkṣasas we are told that "they are to be ten *tâlas*.[2] These images like those of the Asuras, Pisâchas and Râkṣasas, who may be figuratively regarded as their tribesmen, are to have "long thighs and legs, to be ferocious, cruel and vehement,[3] or sometimes very lean and thin."

Forest Tribes.

Kirâtas are a class of Âraṇyaka or forest-tribes. They have been mentioned only once in *Sukranîti*, and that in connexion with the division of the Army into two orders—that of the Standing Army and that of the Militia or National volunteers. To this latter class belong the "Kirâtas[4] and people living in the forests who have their own resources and depend on their own strength." These wild tribes are enlisted as soldiers, and they bring their own arms and accoutrements. These are probably independent races who do not ordinarily acknowledge suzerainty of the neighbouring chief.

Âryas.

The word 'Arya' has been mentioned only once. We are told that the "man who abuses the Âryas[5] and the gods" is one of those who are to be expelled by the King from the Commonwealth.

SECTION 3.

Identification.

We have now gone through the accounts of the Sukra poets about the various races mentioned by them in their work. It is doubtful if we should regard Purvadevas or Asuras, Râkṣasas, and Pisâchas referred to in the treatise as races of men, for they are really half-men, half-gods, belonging rather to the regions of demons, goblins and giants than to the mundane world of human beings. As for the others, the details are very few indeed. Except the Khaśas who can be identified, as they have been in Stein's *Raj Tarangiṇi*, the Yavanas, Mlechchas and Kirâtas are more or less generic names of races very difficult to identify until the date of *Sukranîti* is fixed. This is, as I have suggested previously, *petitio principii* at the present stage of our knowledge regarding the branch of Hindu literature known by the name of *Arthasâstras* or *Nîtisâstras*.

[1] Sukra I, 287-290.
[2] Sukra IV, iv, 171-172.
[3] Sukra IV, i, 105-106.
[4] Sukra IV, iv, 398-890.
[5] Sukra IV, vii, 28.

The terms *Mlechcha* and *Yavana* are very elastic, " chartered words " as they are called, and have been very loosely applied by Indian authors to anybody who is not of their race, religion or country. They correspond to " Barbarians " of the Hellenes, " Pagans " or " Heathens " of the Christians, " Kafirs " of the Musalmans, and " Welsh " of the English people. That these terms had definite 'connotation' as well as " denotation " in the initial stages of their history there is no doubt. But in the course of time, at any rate in *Sukraniti*, they have come to be almost identical or synonymous, and as we have seen, both of them metaphorically used to indicate anything that is ignominious, vile or despicable. What, however, we can definitely gather from the passages in the works of the Sukra Cycle leads us to the idea that perhaps the term *Mlechcha* is the genus and *Yavana* is one of its species. Thus Yavanas are a class of men who belong to the Mlechcha group of human races.

The term *Kirâta*, again, had a special significance when first used. But in *Sukranîti* it seems to be a generic name for all forest tribes without any special race-characteristics.

Though *Sukranîti* is silent about the homes, characteristics, etc., of the races incidentally mentioned in it, it would be interesting to know them from other sources. We, therefore, proceed to throw a sidelight on these races from accounts to be found in Sanskrit Literature.

Yavanas.

We have already discussed the locality and nationality of the Yavanas and quoted at length Dr. Mitra's conclusions. We may mention here that the word *Yavana* is not to be found in Vedic literature. The newly published " *Vedic Index of Names and Subjects* " (in two volumes) by Messrs. Macdonell and Keith does not notice either Yavanas or Mlechchas among the sixty-six tribes[1] or races enumerated in its index. The following observations of Principal P. T. Srinivas Iyengar,[2] however, are important not only as throwing some light on who may be regarded as the counterpart of the Yavanas and Mlechchas in the age of the *Mantras*, but also as contesting the orthodox theory of the Aryan invasion of India :

" The Vedic Mantras mention the names of about forty tribes who inhabited the regions known to their composers. * * * * Scholars have given the name 'Aryas' to those tribes among whom the Mantras were composed and applied the name to a supposed Aryan race which sent successive swarms of invaders to India, Persia, Greece, Italy, Germany, France, Britain, and civilised those lands in pre-historic times. But the progress of anthropology has proved the invasion and civilisation of Europe by the 'Aryans' to be a myth. Scholars yet cling to the theory of an 'Aryan' race so far as India is concerned. * * * The Aryas and Dasyus or Dâsas are referred to not as indicating different races, * * * The words refer not to race but to cult. * * * Ârya meant a worshipper of Indra (and Agni), and Dâsa or Dasyu meant either demons

[1] See pp. 590-1.

[2] *Life in Ancient India*, pp. 8-15.

opposed to Indra or the people that worshipped these demons. * * * The Dasyus are without rites, of different rites, fireless, non-sacrificers, without prayers, without Riks, haters of prayer. * * * * Thus the difference between the Âryas and Dasyus was not one of race but of cult. Nor was there any difference of culture between the Ârya and Dasyu. The Dasyus lived in cities * * * possessed wealth, * * owned many castles. * * * Indeed Dasyu and Arya have been understood respectively as enemies and advocates of the fire-cult * * Sâyana defines Âryas to be those that sing hymns, practising fire-rites, and Dasyus to be enemies who destroy the observers of fire-rites, riteless."

Leaving aside the controversy as to whether the distinction was one of cult and faith only or of culture and race also, we need not hesitate to look upon the Dasyus or Dâsas, the enemies of the Âryas, as the "Yavanas" of Vedic India according to the definition of Sukrâcharyya.[1]

The following extract from Mr. C. V. Vaidya's *Epic India*[2] would throw a fresh light on the topic.

"In the Vedas the Aryans speak of themselves as distinguished from the Dâsas or aborigines and the Asuras or Iranians. Gradually through the epic period they lost sight both of the Iranians by distance and of the Dâsas or aborigines by extinction or assimilation. They now spoke of the Aryans as distinguished from the Mlechchas who surrounded their country. Let us examine who were included in that word. When the cow of Vasistha created the Mlechchas to destroy the army of Viswâmitra who was trying to take her away by force it is stated that the cow created from the serveral parts of her body the Pallavas, the Drâvidas, the Shakas, the Yavanas, the Shabaras, the Paundras, the Kirâtas, the Sinhalas, the Barbaras, the Khasas, the Chibukas, the Pulindas, the Chînas, the Hunas, the Keralas, and many other Mlechchas.[3] * * * It appears plain that the Dravidian peoples of the south were looked upon as Mlechchas equally with the Yavanas and Shakas. It seems also probable that the Aryans of India knew these Yavanas and Shakas and Hunas and Chînas long before they actually invaded India."

In *A Peep into the Early History of India*[4] Dr. Bhandarkar identifies the Yavanas with the Bactrian Greeks on the strength of a passage from Patanjali and the tradition alluded to by Kâlidâsa in the *Mâlavikâgnimitra* that Pushyamitra's sacrificial horse was captured on the banks of the Sindhu or Indus by Yavana cavalry. "The instances given by Patanjali * * * are *Aruṇad Yavanâh Sâketam* : *Aruṇad Yavano Madhyamikam*. This shows that a certain Yavana

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[1] Sukrâchâryya's account of Yavanas, who respect authority other than that of the Vedas and who have their own spiritual masters, exactly corresponds to this description of the enemies of the Vedic Aryas.

[2] Pp. 25-26 (Edition of 1907).

[3] It would thus appear that Yavanas are a species of Mlechchas, as has been suggested above; not Yavanas only, but also the Khasas and the Kirâtas mentioned in *Sukranîti* are thus two branches of the Mlechchas.

[4] Journal of the Bombay Branch of the Royal Asiatic Society (1900), pp. 370-72.

or Greek prince had besieged Saketa or Ayodhya and another place called Madhyamika when Patanjali wrote this. The late Dr. Goldstücker identified this Yavana prince with Menander. * * * In another place Patanjali gives *Saka-Yavanam*, as an instance of an aggregate *Dwandwa* which signifies that they were Sudras and lived beyond the confines of Âryâvarta." In an analysis of the historical inscriptions in the Cave-Temples of Western India[1] Dr. Bhândarkar says: "Gotamiputra Satakarṇi quelled the boast and pride of Kṣatriyas and destroyed the Sakas, Yavanas and Pailavas." On the evidence of inscriptions and coins his conclusion is that the Gracko-Indian or Yavana kings[2] were in possession of parts of India from about the beginning of the second century before Christ to the arrival of Sakas.

Dr. Bhandarkar's testimony refers to the Yavanas as rulers or warriors, and as such we find them in Ayodhyâ in Upper India, and also in the Deccan, the land of the Satavâhanas or Andhrabhrityas. But as a people with a certain culture, language and faith the Yavanas have been known to the Indians since at least the sixth century B. C. when Paṇini the great grammarian[3] flourished.

Mlechchas.

About the more generic word Mlechchas we qoute the following from Mr. Vaidya's *Epic India*:[4]

"At the end of the Epic Period the word Ârya comprises not only the three castes, but also the Sudra within it and is opposed to Mlechchas." Thus "all peoples who are outside the castes born of the head, the arm, the thigh, and the foot of Brahmâ, whether they speak the Aryan or the Mlechcha languages are Dasyus." (Manu X, 46.)

The following is also taken from the same work:

"The Mahâbhârata, Bhisma Parva, Chapter IX, mentions 157 peoples in Hindustan properly so called, 50 peoples in the south, *i.e.*, to the south of the Nerbudda, and about 14 Mlechcha peoples beyond India in which term we include Afghanistan as well as Kashmir. * * * The countries and peoples to the east[5] were originally looked upon as Mlechchas.[6] They were the Angas, Vangas and the Kalingas. * * The Northern[7] Mlechchas comprise almost all those people who were undoubtedly known at the end of the epic period after the conquests of Alexander. But we cannot but believe that many of these peoples must have been known to the Aryans several centuries before."

"The Mlechchas[8] who attempted to speak the Sanskrit language committed mistakes," as would be evident from the following verse in the *Âdi*

[1] Early History of the Dekkan, Section IV.

[2] A Peep into the Early History of India.

[3] Dr. Rajendralala Mitra's *Indo-Aryans*, Vol. II, (Edition of 1881), pp. 177-178

[4] P. 27.

[5] East of the Gandaki, the river mentioned in *Sukraniti* also.

[6] Vaidya's *Epic India*, pp. 280-288.

[7] *Ibid*, p. 271.

[8] *Ibid*, p. 331.

Parva of Mahâbhârata: " *nâryâ mlechchhantibhâshâbhih* " or the Aryas do not 'mlechchhise' in speech, *i.e.*, as the commentator explains it, do not commit mistakes in speaking, as has been already alluded to in connexion with Yavanas. The Mahâbhârata constantly speaks of the Aryas, *i.e*, the orthodox population of the country between the Himalayas and the Vindhya range as distinguished from the Mlechchas who inhabited countries beyond these whether to the East, South or the West. In the *Bhisma Parva* it is expressly stated in the beginning that the peoples were Aryâs, Mlechchas and mixed races."[1]

The metaphorical or non-literal use of the words, Ârya, Yavana and Mlechcha in certain passages of *Sukraniti* has already been hinted at. There are instances of this use in the Mahâbhârata also. Mr. Vaidya says: "The Aryans had not only not forgotten their race, but had also not forgotten the superiority of their race in morality, and we find the epics constantly using the word *Arya* to signify what is good and high, conscious of the facts that the word meant originally a race and that high morals were characteristic of that race only. *Anâryajushta*[2] is an expression of frequent occurrence in the epics showing that "not practised by the Aryans" was synonymous with "not good" or "not moral."

For the earliest use of the word Mlechcha we have to refer to a passage in the Satapatha Brâhmaṇa, "where it occurs in the sense of a barbarian[3] in speech. The Brahmana is there forbidden to use barbarian speech."

The long extracts from the works of Mr. Iyengar, Dr. Bhandarkar and Mr Vaidya must have made it clear that the Yavanas and Mlechchas have been names of different peoples in different periods scattered over various parts of India; and until and unless the date of *Sukranîti* is fixed it is impossible to identify the tribes who are meant by the poets of the Sukra Cycle in the passages which describe them as living in the North and West, professing non-Vedic faith and obeying their own spiritual guides. Or perhaps in these lines we have a clue to the date of the work, or at any rate, of certain portions of it. For whatever be the age of other parts of *Sukranîti*, it may be presumed that these lines were the composition of men at the time when Yavanas were definitely known to live in a specified quarter of India, namely *pratyaguttara*, *i.e.*, 'North-Western' or 'Northern *and* Western.'

Âryas.

We have incidentally noticed above that the word *Ârya* was often used not for a race but for the qualities of good breeding, etc., that the civilised people or orthodox Indian nations represented. In the passage quoted above from *Sukranîti* regarding the persons who abuse the Aryas as well as gods, it is doubtful if the word has been taken literally or metaphorically. But from the general trend of the whole treatise we may gather that a people "consisting of all the

[1] Vaidya's *Epic India*, pp. 23-24.

[2] Vaidya's *Epic India*, p. 24.

[3] Note on the word *Mlechcha* in the *Vedic Index* by Macdonell and Keith, Vol. II, p. 181.

four castes is here meant as distinguished from the Mlechchhas." Messrs. Macdonell and Keith[1] give the following history of the word in Vedic literature: " Arya is the normal designation in the Vedic literature from the Rig-Veda onwards of an Aryan, a member of the three upper classes, Brahmana, Kshatriya, or Vaisya. * * * The Arya stands in opposition to Dâsa, but also the Sudra. Sometimes the expression is restricted to the Vaisya caste. * * * The word Arya also occurs frequently as an adjective to describe the Aryan classes or names. * * * Aryan foes are referred to beside Dâsa foes, and there are many references to war of Aryan *versus* Aryan. * * * In the later Samhitâs and Brâhmanas the wars alluded to seem to be mainly Aryan wars." It is thus clear that the three upper castes were called Âryas and the lowest the Dâsas. In the course of time, *i.e*., during the post-Vedic ages, the lowest classes, the Dâsas or Sudras, constituted the fourth caste of the Aryas. And the name Arya became opposed to Mlechchha, as we have seen above in the extracts from Mr. Vaidya's *Epic India.*

Kirâtas.

The Kirâtas have been mentioned in the Mahâbhârata as a species of Mlechchhas born out of Vasistha's cow. Kalidasa's hero, Raghu, in his *digvijaya* or ' conquest of the quarters of the globe' overpowers the Kiratas and other hill-tribes, somewhere near the Kailâsa mountain in the Himalayan ranges. The word is found in Vedic literature also. The following is taken from the note on the word in the *Vedic Index of Names and Subjects*: [1] " Kirâta is a name applied to a people living in the caves of the mountains. * * Later, the people were located in Eastern Nepal, but the name seems to have been applied to any hill-folk, no doubt aborigines, though the *Mânava Dharma Sâstra* regards them as degraded Kşatriyas.

Râkşasas and Pisâchas.

It has already been remarked that Râkşasas and Pisâchas, as used in *Sukranîti*, seem to be half-men, half-gods, and not full human beings. " In the early Vedic literature[2] Râkşas refers to demons, and is only metaphorically applied to human foes. No definite tribe is meant." This is the verdict of Messrs. Macdonell and Keith, who also assert that "similarly Pisâchas are not a tribe in Vedic literature, whatever they may have been later." The following is their note to the word *Pisâcha*: " Pisâcha[3] is the name of a class of demons mentioned in Atharvaveda and later. In the *Taittiriya Samhitâ* they are associated with Râkşasas and Asuras, while opposed to gods, men and fathers. In the Atharvaveda they are described as eaters of flesh. * * It is possible that the Pisâchas were, as suggested by Grierson, really human foes like the north-western tribes. * * This is, however, not at all likely."

The following extracts from Mr. Vaidya's *Epic India* give us some idea of the homes of the Râkşasas, whether regarded merely as 'ghouls' or real

[1] *Vedic Index of Names and Subjects*, Vol. I, pp. 64-5, in the " Indian Text " series.

[2] Vol. I, pp. 157-158.

[3] *Ibid*, Vol. II, 516.

human beings : "The Rakshas and Râkshasas were originally a people who lived on the sea-coast. * * * Even in their conquest of the Punjab and the Upper Gangetie valley the Aryans must have sometimes come in contact with fierce cannibalic Dravidian races. * * * Aryan adventurers * * plant colonies in the Central Provinces only at suitable places, though they were frequently infested by Râkshasas. * * * In the Râkshas form of marriage the bridegroom was allowed to abduct by force the daughter of a Kshatriya whether she was a willing party or not. * * * The modern Deccan was pre-eminently the country of the Râkshasas."

Asuras.

Asura is a very important word in Sanskrit literature, both Vedic and post-Vedic. We are especially interested in it, as our author Sukra is the *guru* or preceptor of the Asuras.

Rev. K. M. Banerjea is one of the first scholars to have studied the etymology of the word 'Asura' and the nationality of the race denoted by it. The following is taken from the Preface to his *Arian Witness*:[3] "No term in the Rig-Veda seems to have puzzled students, translators and commentators more than the word Asura. The modern idea denoted by the term is that of an ogre and a demon. The idea is annually embodied in the person of the Mahisâsura among the figures worshipped at the Durga Puja. He appears there as the fiercest of the goddess's enemies receiving his death wounds at her hands. In the Rig-Veda, however, the gods themselves are, all of them termed and accosted as Asuras, and one of them, introduced at the moment as the Creator of the Universe, is called the *all-knowing and wise Asura*. And yet the same Veda elsewhere gives an opposite picture of the character indicated by the term, corresponding to the modern ideal of a demon and an ogre, and the very same individuals are sometimes represented as Asuras, and again lauded as destroyers of Asuras. * * The Rig-Veda continues a witness of both senses, but the later Vedas and all subsequent *Sâstras* give exclusively the odious sense of evil spirits, hostile to gods and Brahmanas and inimical to their long-cherished institution of sacrificial ceremonies."

This double character of the Asuras as (1) gods as well as the people who worship the gods, and (2) devils as well as the people who worship the devils has been explained by the evidences of Comparative Philology. The two branches of the Primitive Aryans, *viz.*, the Iranians (Persians) who have developed the *Zend Avesta* with the theogony of the Asuras, and the Indo-Aryans (Hindus) who have developed the Rig-Veda with the theogony of the Devas were once living on the same soil in a common home. Various causes of differentiation led at last to their separation as enemies and vilification of each other. The two stages of their relations, *viz.*, friendly as well as inimical, have been portrayed in the sacred literature of both the peoples. It is in the second stage

[1] Vedic Index by Macdonell and Keith, Vol. I, p. 593.

[2] Vaidya's *Epic India*, pp. 6, 7, 8, 306.

[3] Published by Thacker, Spink & Co. (1875).

of their relations that the Iranian devils are the Indo-Aryan gods, and the Indo-Aryan devils are the Iranian gods. Thus the *Asuras*,[1] who are the beneficent gods of the western branch of the Aryans, have become the worst enemies of the *devas*, the gods of the eastern branch; while the *devas* of the eastern are the devils of the western.

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[1] This interesting topic has been dealt with by Dr. Râjendralala Mitra in his paper on *Primitive Aryans* in *Indo-Aryans*, Vol. II, and also in a short article by Mr. Maheshchandra Ghosh in the Bengali Monthly, the *Pravási*, Vol. VI, No. 11, pp. 587-593. For some of the characteristics of these eternal enemies of the Indian gods and peoples, see also Mr. Vaidya's *Epic India*, pp. 23, 25, 27, 93, 131, 294, 293, 353, 464, 504., and Fausboll's *Indian Mythology* (Luzac & Co.)

CHAPTER IV.

THE DATA OF ANCIENT INDIAN MINERALOGY.

SECTION I.

Sukraniti as the 'Architectonic' Science.

Writing about Montesquieu, the French Philosophical historian of the eighteenth century, in his *History of French Literature*, Dr. Edward Dowden says: "The scientific researches of his day attracted him; investigating anatomy, botany, natural philosophy, the history of the earth, he came to see man as a portion of nature, or at least as a creature whose life is largely determined by natural laws. With a temper of happy serenity and an admirable balance of faculties he was possessed by an eager intellectual curiosity. 'I spend my life,' he said, 'in examining; everything interests, everything surprises me.' Nothing, however, interested him so much as the phenomena of human society. He had no aptitude for metaphysical speculations; his feeling for literature and art was defective."

Exactly the same character-sketch would apply to the Hindu sociologist, Sukrâchâryya, if we were to construct his biography out of the internal evidences culled from the literary production that is connected with his name. The same non-metaphysical and pre-eminently human outlook, the same positive and scientific standpoint, the same comprehensive and encyclopœdic conception, the same aversion to literary and artistic flourish mark the intellectual framework of the authors of the Sukra cycle.

The merits and shortcomings of *Sukranîti* are identical with the merits and defects of the *Esprit des Lois*[1] which has been characterised by Janet in his *Historie de la Politique* as "undoubtedly the greatest work of the eighteenth century" and classed with Rousseau's *Contrat Social* as forming together the literary source[2] and spring of the revolutionary movement. The following are the words of Dowden about *The Spirit of Laws*: "The whole of his mind, almost the whole of his existence—is embodied in the *Esprit des Lois.* It lacks the unity of a ruling idea; it is deficient in construction, in continuity and cohesion. * * * It lacks unity because its author's mind was many-sided. * * * He would warn and he would exhort; he would help, if possible, to create intelligent and patriotic citizens. * * * Its ideas often succeed each other without logical sequence. * * * But he brought the study of jurisprudence and politics, in the widest sense, into literature, laicizing and popularising the whole subject; he led men to feel the greatness of the social institution."

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[1] Published in 1748.

[2] Sidgwick's *Development of European Polity* (1903) Lect. XXV.

The same may be said of *Sukraniti*, also, which has proposed for itself the function of prescribing rules for the promotion of human[1] welfare, and the furtherance of the interests of both peoples and kings. One finds in it the same copiousness of illustrations and multiplicity of details, the same occasional defects in arrangement and incoherency of treatment.

The explanation of this strength as well as weakness of the work is to be sought in its very scope and province, which are those of the 'science of all sciences,' the "architectonic" or the dominant science, as Aristotle would call it. Sukraniti, as such a master-science, in order to fulfil its mission as a guide-philosopher-friend to every class of human beings, must survey the whole universe from the planet to the sea-gull, and the daffodil to the star.

Section 2.

The Synthetic Philosophy of Sukráchâryya.

All the facts and phenomena of the mineral, vegetable and animal worlds have bearings on human life and social progress. Professors of the "architectonic" science, therefore, have need of them. According to Comte,[2] social science is subordinate to Biology and is "related to the whole system of Inorganic Philosophy, because Biology is so." "The whole social evolution of the race must proceed in entire accordance with biological laws. * * * It is only by the inorganic philosophy that we can duly analyse the entire system of exterior conditions—chemical, physical, and astronomical—amidst which the social evolution proceeds, and by which its rate of progress is determined."

John Stuart Mill also believes that the scope of any profitable study of man's action in society must be co-extensive with the whole of social science. According to him, "a person is not likely to be a good economist who is nothing else. Social phenomena,[3] acting and re-acting on one another, cannot rightly be understood apart." Dr. Ingram[4] gives prominence to this encyclopædic character of Social Studies in his article on Political Economy in the *Encyclopædia Britannica* (ninth edition). His conclusion is that Political Economy cannot any longer command attention as a fruitful branch of speculation unless it is subsumed under and absorbed into general sociology." Not only economics, but politics also, "can only be scientifically studied as one part or application of the Philosophy of History." Says Professor Sidgwick : "I agree with Mill in holding that the scientific study of the different kinds of governments that have actually existed in human society ought to be pursued in close connexion with the scientific study of other important elements of the societies in question. * * * The division of intellectual labour ought not to

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[1] Sukra I, 4—24.

[2] Carver's *Sociology and Social Progress* (1906), pp. 65—87.

[3] Marshall's *Principles of Economics.*

[4] Keyne's *Scope and Method of Political Economy*, Third Edition (1904), pp. 112—141.

be carried so far as to make us forget the influence exercised on government by other social changes,[1] for instance, by the development of thought, of knowledge, of morals, of industry." The science of Public Finance, also, which is closely related to Economics, Politics and History, is, as such, a study of man's social activities, and hence only one of the branches of the Architectonic science—Sociology.

The differentiation and specialisation of the sciences according to the principles of the division of labour have undoubtedly rendered immense service to the world of speculation. The physical sciences have been rendered more and more precise, mathematical and exact. The human sciences also have tended in the same direction. But this 'progress' of the sciences in the acquisition of mathematical accuracy has necessarily deprived them of their realistic and concrete character. The growth in 'exactness' and necessary abstraction has militated against the efficacy and utility of each alone as a manual of guidance to human beings. Modern philosophical thought is fully conscious of this 'other side' of specialisation, and recognises the limitations of the specialised sciences in the matter of framing practical rules or duties of life. Thus Dr. Keynes observes : "Few practical problems admit of complete solution on economic grounds alone. * * * More usually when we pass to problems of taxation, or to problems that concern the relations of the state with trade and industry, or to the general discussion of communistic and socialistic schemes—it is far from being the case that economic considerations hold the field exclusively. Account must also be taken of ethical, social, and political considerations that lie outside the sphere of Political Economy regarded as a science * * * If the art attempts a complete solution of practical problems, it must of necessity be to a large extent non-economic in character." This defect is inherent in all specialised sciences. The science, therefore, that would lay down absolute rules for the regulation of human conduct, cannot with advantage be separated from general political and social philosophy.[2]

Sukraniti is such a science or art of social philosophy and legislation. The authors of the Sukra cycle, without caring to expound their methods of investigation and explain the 'logic' of their science, have unconsciously followed the method of the most synthetic and comprehensive art that would turn to account all the physical and human sciences in order to prescribe the 'whole duty of man.' The countrymen of Sukrāchāryya were not, however, poor in methodology. The ancient scientific machinery of the Hindus has found an able exponent in Dr. Brajendranāth Seal,[3] whose short but erudite monographs have furnished the sound philosophic basis of the modern Indian school of historico-sociological research.

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1 Sidgwick's *Elements of Politics* (1891), pp. 5—6.

2 Keyne's *Scope and Method of Political Economy*, Third Edition (1904), pp. 55—58.

3 For Seal's Mechanical, Physical and Chemical Theories, as well as Scientific Method of the Ancient Hindus, see Dr. Ray's *Hindu Chemistry*, Vol. II., pp. 59—200.

SECTION 3.

The Place of Mineralogy in Sukraniti.

It is this comprehensive view-point of the Sukra legislators that supplies the *rationale* of their discussion of purely physical and material phenomena in their treatise on morals. Investigations regarding stones, gems, metals, minerals, buildings, roads, gardening, images, forts, arms, weapons, plants and animals—all these are integral parts of the *Nitisâstra*, according to this conception, which otherwise would remain incomplete. Mineralogical, Architectural, Sculptural, Botanical, Zoological, Veterinary and Agricultural ideas have thus a natural and necessary place in the *Sukraniti*, and are not mere appendages calculated to swell its bulk.

Consistently with this, we might expect greater prominence given to climatological and general geographical facts in the work of the Sukra statesmen, as in the work of Montesquieu. But, as we have seen, *Sukraniti* is rather defective in this respect. It treats of the geographical and meteorological phenomena in a very subsidiary capacity. As auxiliary to the main study, Sukra authors might devote greater attention to the Earth which is the theatre of all human activities and one of the principal aspects of the positive background of a people's social life. The authors, however, refer to the hills and rivers, seas and seasons very casually and incidentally, as it were, to illustrate their points or explain their ideas. This is all the more strange, since the observation and tabulation of natural phenomena were regularly instituted in ancient India in order to determine the fortunes of men and princes. Thus the *Brihat Samhitâ*, an astronomical and astrological work of the 6th century A.D., is a comprehensive study[1] of the physical features and aspects of the universe, *e.g.* clouds, rains, planets, winds, earthquakes, storms, plants, animals, jewels, &c., and of their influences on the course of human affairs—social, economic, and political. This treatise is the "*Physics and Politics*" of the Hindus written about 1500 years ago, and anticipates "*the Spirit of Laws*," the first important European work on the study of physical forces and energies, as affecting human history by, over eleven centuries.

The treatment of mineralogy in *Sukraniti* is threefold :

(1) As a feeder or contributor to the 'architectonic' science, Sociology, the position of Mineralogy is inevitable like that of the other physical sciences.

(2) As incidental or stray references which cannot be prevented in any work of considerable proportions, Mineralogical, like Botanical, Engineering,

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[1] The scope and province of this work have been described by the author himself in Chapter II. See Iyer's Translation (printed at the South Indian Press, Madura, 1884), pp. 3-12. See along with this Buckle's *History of Civilisation*, Vol. 1, Montesquieu's *Spirit of Laws*, Book XIV (English Edition in the *World's Great Classics Series*), Bagehot's *Physics and Politics*, Dunning's *Political Theories*, Vol. II, pp. 418-428, 112-113 (Macmillan 1905), Bluntschli's *Theory of State* (Third Edition, 228-236). In 1880-1882, a trial was made in the Baroda State to ascertain whether the probable rainfall of the coming monsoon could be predicted from observations of clouds according to principles laid down in *Brihat Samhitâ*. The result was eminently successful.

Zoological, and other ideas of physical science, furnish valuable clues to the general culture of the epoch or epochs in which portions of *Sukranîti* might have been composed. Our treatment of Geographical Data in a preceding chapter has been mainly directed by this search for 'internal evidences,' as they are called.

(3) As directly bearing on the socio-economic and socio-political interests of man. The authors of the Sukra cycle have a judicious sense of proportion and scientific selection. They are not tempted to long-winded and labyrinthine inquiries involving prolix digressions within digressions that characterise the *Encyclopædia Indicas*, called the *Purâṇas*. Facts of physical science have been laid under contribution only according to their need. These writers have displayed the same rational discrimination that marks the literary activities of modern thinkers. Says Dr. Keynes:[1] "While Economics has to take account of the operation of physical laws, it is still concerned with them only indirectly. It does not seek to establish or explain the physical laws that are involved in agriculture or mining or manufacture. This is the function of such sciences as mechanics, chemistry, geology and the science of agriculture. * * * The relation of political economy to the physical sciences is then simply this, that it pre-supposes them; it is sometimes concerned with physical laws as premisses, but never as conclusions. * * * The science is not directly concerned with the technique of different trades and occupations."

In treating of the minerals, metals, stones, &c., (as the other facts of physical world), the philosophers of the Sukra cycle have closely followed the method of the moderners. Thus the chemical, crystallographical, medicinal, and metaphysical speculations over the gems and metals have been sedulously avoided by them. *Sukranîti* has referred to the metals and precious stones only as they affect the economic, financial and political life of the people. The Data of ancient Indian Mineralogy that this work on social and moral legislation yields would thus afford a valuable picture of the commercial geography and economic history of the country in by-gone days, as we have hinted at in a preceding chapter. For, though "the distribution of minerals over the surface of the earth is much less obvious phenomenon than that of plants and animals, it has always been of great importance[2] in determining the distribution of man and his settlements."

Like the geographical data, these would supply some of the evidences by which it may be possible to fix upon the *locale* of certain portions of the treatise as well as their date.

SECTION 4.

History of Hindu Mineralogy.

(a) *Literature on Metals.*

The philosophers of the Sukra cycle have drawn upon mineralogical literature very sparingly indeed. One cannot but admire the sobriety and

[1] Keyne's *Scope and Method of Political Economy* (1904), pp. 84-86.

[2] Newbigin's *Modern Geography* in the Home University Library Series.

restraint of these authors when one remembers how easily they might tend to indulge in the mythological, alchemical and metaphysical notions regarding the mineral world which held sway over both the East and the West[1] for centuries. The Sukra authors have very creditably displayed their ratiocinative intellect and scientific spirit by rejecting all other aspects of precious stones and metals known in their literary circles, and using only such facts and figures as are relevant to the socio-political scope of their work.

For the uses of minerals have been known to the Hindus from the earliest times. In 1877 the late Dr. Udoy Chand Dutt brought out his *Materia Medica of the Hindus*,[2] in the first part of which he gave on account of the mineral or inorganic medicines used in ancient times under five heads : (1) mercury, (2) metallic ores and earths, (3) metals, (4) salts, (5) precious stones ; of the mode of their preparation, their chemical composition, and the principal combinations in which they were employed in different diseases. About the same time Dr. Rajendralal Mitra's *Indo-Aryans* and *Antiquities of Orissa* revealed to a certain extent the knowledge of the ancient Hindus in the use of metals and gems in arts, industries and handicrafts.

In order to appreciate the value of Hindu mineralogical literature that is implied and indicated by the actual use of minerals for the diverse purposes of human life, it is necessary to estimate the present character and history of the science as it obtains in Europe.

"Mineralogy[3] is the science which describes and classifies the different kinds of mineral matter constituting the material of the earth's crust and of those extra-terrestrial bodies called meteorites. The study of minerals is thus a branch of natural history, but one in which certain of the exact sciences find an application. The determination of the composition and constitution of minerals is a chemical problem ; their optical and other physical properties are determined according to the principles of physics ; the study of the crystalline form and structure belongs to crystallography ; their modes of occurrence, origins, associations and changes come within the province of geology and petrology ; while a consideration of the localities at which they are found requires some acquaintance with geography. Finally, there is the economic side, dealing with the mining and application of useful minerals, the extraction of metals from their ores and the uses of minerals for building, decoration and jewelry."

The above description of the science can apply to Mineralogy in its last and very modern phase since about 1860. Says the Editor of the *Mineralogical Magazine* :[4] "It was not until the end of the 18th and beginning of the 19th century * * * that any advance was made in scientific mineralogy. It was then

[1] For an account of the progress of Alchemy in Europe, see the *Story of Alchemy* by Muir in the *Library of Useful Stories* Series.

[2] The materials supplied by this work have been subsequently laid under contribution in the preparation of *Hindu Chemistry* by Dr. P. C. Ray and in the work of Goudal.

[3] *Encyclopædia Britannica*—11th Edition.

[4] *Encyclopædia Britannica*—11th Edition.

recognised that * * * * external characters were more or less accidental. * * * In 1809 exact measurements of crystalline forms of many minerals were made. * * * In 1819 and 1821 * * * impetus to optical examination. * * * Under the microscope * * exact determination (1867)."

It would thus appear that in the west the scientific era is essentially modern, to be counted only by generations. All writers on minerals and allied subjects have up to the beginning and the first two decades of the 19th century been interested only in such aspects as would, in modern phraseology, be regarded as mainly 'unscientific.'

Such Hindu writers on minerals in ancient and mediæval mines are a legion. It has been a fashion for long to credit very little of original achievetnents in secular literature and civilisation to the people of Hindustan. But this notion is being falsified by the explorations and researches of Indologists. So far as minerals and jewels are concerned, Sanskrit literature[1] has been very prolific in producing treatises which have varied from epoch to epoch, according to the changes in the culture of the people. We have already referred to. Dr. Dutt's survey of the chemico-medical uses of minerals by the ancient Hindus. This work is based on standard Sanskrit medical works and has copious references to the original literature on the subject. Dr. Prafulla Chandra Rây has discussed the historical, chemical, medicinal, metallurgical, and generally the scientific values of some of these treatises or sections of treatises in his celebrated *History of Hindu Chemistry*. The late Dr. Râmdâs Sen of Moorshidabad[2] contributed in Bengali a monograph on the gems from original Sanskrit sources and edited the *Agasti-matam*, *Ratna-Samgrahâ* and *Maṇi-parikṣâ*, three Hindu works on precious stones. The subject of precious stones and jewels has also received an elaborate and comprehensive treatment in Bengali, especially in their crystallographical, economic, and geological character, in the hands of Prof. Yogês Chandra Roy of Cuttack, who has tried to interpret the knowledge of the ancient Hindus in the light of the modern sciences. The enlightened Doctor of Music, Râjâ Sir Saurindramohan Tagore's work on gems called *Maṇimâlâ*,[3] published in 1881, covers over one thousand pages. This encyclopœdic work compiled in Sanskrit, Hindi, English and Bengali languages has drawn illustrations from over one hundred Sanskrit, English and Persian works. Of these, the number of Sanskrit authorities consulted is sixty-four.

Among the modern exponents of Hindu culture in these branches, Dr. Tagore's monumental work was followed by Dr. Sen's. Neither of them, however, tried to combine the East with the West in their endeavours. That has been

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1 The *Vâstuvidyâs*, *Silpasâstras*, &c., and other branches of Hindu secular literature will be treated of in a subsequent chapter.

2 With the help of Pandit Kâlivara Vedântavâgisa (1885).

3 See *Ratna-parikṣâ* by Prof. Yogesh Chandra Roy, who has also noticed the work of Sir Râjâ Râdhâkânta Dev, the *Savda Kalpadruma*, a Sanskrit Encyclopædia (1822-1858).

done by Dr. Dutt, Dr. Prafulla Chandra and Prof. Yoges Chandra, who have succeeded them and brought their scientific scholarship to bear on the mineralogical literature of the ancient Hindus. It is from the learned works of these scholars that the following summary of treatises on metals and gems has been compiled.

Mineralogy is not the *forte* of the Sukra philosophers. They are not specialists in this branch of learning. At any rate, their scope does not allow them to display any special knowledge regarding the metals and gems. They have to deal with these things, because they are the 'sinews of war' and form the *koṣa* (or treasure) or one of the seven constituents of the *Râṣṭra* or the state. Their knowledge of these valuables must, therefore, depend on the literature of the specialists who flourished along with them. But as the geography as well as chronology of the authors of the Sukra cycle are anything but certain, it is all the more necessary that we should have an idea of the progress of the Hindus in mineralogical knowledge. For it is then only that one can assign the historical and geographical value of the section on metals and gems in *Sukraniti*.

The knowledge of the Hindus on the subject of metals has been discovered in all branches of Sanskrit literature from the earliest times to the middle of the sixteenth century A. D. From Dr. P. C. Roy's Survey of Hindu Chemical[1] literature we get *pari passu* the following epochs of mineralogical culture in ancient and mediæval India :

I. VEDIC LITERATURE.[2]

The following is the list of metals compiled for the *Vedic Index*[3] by Macdonell and Keith : *Ayas* (bronze, iron), *Kârṣṇâyasa* (iron), *Candra* (gold), *Jâtarupa* (gold), *Trapu* (tin), *Rajata* (silver) *Loha* (copper), *Lohâyasa, Lohitâyasa, Syâma* (iron), *Syâmâyasa, Sisa* (lead), *Suvarṇa* (gold), *Harita* (gold), *Hiraṇya* (gold).

" Rudra[4] is described as shining with brilliant golden ornaments. * * * The Aswins are also adorned with golden ornaments. The Asuras had plenty of gold and jewels," " Blacksmiths[5] made spears, swords, hatchets, needles, awls, iron legs for those who had lost their natural ones, iron-forts * * * Goldsmiths melted gold and fashioned bright jewels."

[1] This survey is necessarily connected with the history of medical knowledge of the Hindus, and is in fact another aspect of the same thing. Dr. Rây's work therefore closely follows, and is to a certain extent based upon, that of Dr. Dutt. See Dr. Sen's chapter on metals in *Ratnarahasya*, also Prof. Yogesh Chandra's Essay on metals in *Ratnaparikṣâ*. See the *History of Aryan Medical Science* by the Thakur Saheb of Gondal (1895), pp. 134-138, 145-147, and *Medicine of Ancient India*, Part I, Osteology (Oxford, 1907) by Dr. Hoernle, pp. 1-18.

[2] See *Atharava-Veda* in the *Harvard Oriental Series* pp. 17 (amulet of lead), 35 (gold amulet), 272 (amulet of three metals).

[3] See Vol. II, p. 584.

[4] Râjendralâl Mitra's *Indo-Aryans*, Vol. I, p. 227, which gives several evidences from the Vedas about the knowledge and use of metals.

[5] Srinivas Iyengar's *Life in Ancient India in the Age of Mantras*, pp. 28-29, p. 41.

Not only as the materials for arts, industries or as 'measures of value,' but also as having healing powers we find the minerals mentioned in the Vedas. "It is of interest to note the alchemical[1] notions which had gathered round gold and lead at the time of the Atharva Veda. * * While gold is regarded as the elixir of life, lead is looked upon as the dispeller of sorcery." "According to Roscoe and Schorlemmer, the ancient Hindus were the first to discover gold. All the appellations that have been applied to gold by different peoples of the ancient world bear testimony to this statement. * * According to Roscoe and Schorlemmer,[2] the different nations gained their knowledge of extracting iron from its ores from the Hindus."

II. AYURVEDIC LITERATURE[3] (from the Pre-Buddhistic era to 800 A.D.)

(1) The *Charaka Samhitâ*, based on the medical treatise of Agnivesa, mentioned in pre-Buddhistic literature, indicates "the six metals[4] and their calces as drugs appertaining to the earth," discusses the nature of the alkali, treats of the five kinds of salts, mentions sulphates of copper and iron as minerals for external application, and describes iron, gold and silver tonics.

(2) *The Susruta Samhita*,[5] later than the *Charaka*, *par excellence* a treatise on surgery, treats of the preparation and use of alkalies and alkaline caustics, recommends the six metals and their calces as drugs in 'only one śloka,' has 'vague references' to mercury, and describes lead and tin as vermifuge.

(3) *The Bower MS.*,[6] a medical work attributed to one Susruta, copied within the period from 400 to 500 A.D., mentions sulphates of copper and iron as ingredients for hair-dye and considers Bitumen as a product from the following four metals : gold, copper, silver, iron.

(4) The *Aṣṭânga hridaya* of Vâgbhata (probably a Buddhist of Sindh, 8th cent. A.D., but according to Dr. Kunte, of the 1st or 2nd cent. B.C.), 'the heart or kernel of the eight limbs or divisions of Ayurveda,' is mainly an epitome of the *Charaka* and the *Susruta*, mentions mercury only once and treats of the preparations of gold, silver, copper, iron and lead.

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[1] *History of Hindu Chemistry*, Vol. I, First Edition, pp. vi, vii.

[2] Quoted from Major B. D. Basu's Prize-Essay on the *Hindu System of Medicine* published in Guy's *Hospital Gazette* (1889).

[3] See the *Preface* to Dr. Dutt's *Materia Medica of the Hindus* for the medico-chemical (mineralogical) literature of this period, also references to original authorities in the body of the book.

[4] Quoted by Dr. Rây from A. C. Kaviratna's *Translation of Charaka Samhitâ*, pp. 6-7.

[5] See the Bengali translation by Kavirâj Devendranâth Sen (1900), p. 208, where *seven* metals have been mentioned, the additional one being bell-metal, and *ranga* is used for *vanga*, i.e., *trapu* (tin).

[6] Edited by Dr. Hoernle, published by the Superintendent of Government Printing, Calcutta (1893-1909). See Part II, Fasciculus II, pp. 102-104. The drugs recommended are mainly vegetable. For references to metals, gold, copper, &c., and gems, see General English Index.

(5) During this period also must be mentioned the vast mass of Hindu, Jaina and Buddhistic literature in Sanskrit and Prâkrit, which embodies the original and characteristic products of Indian intellect, and in which are mirrored the brightest epochs in the history of Indian culture. This is the period[1] of Indian history properly so called, as it covers roughly the interval between the age of precursors of Paṇini[2] and Buddha and the epoch of Harṣavardhana and Houen Tsang,—the last prominent landmark of Hindu civilisation,—or if we push this limit further down, the age of the Pâlas of Bengal and the Cholas of the South in the 8th and 9th centuries A.D.

Dr. Dutt's *Materia Medica* does not, from the nature of the subject, refer to any authorities other than medical. Dr. P. C. Rây's work also is silent about the non-Ayurvedic branches of Indian literature during this period of over 1,600 years regarding the light they throw on alchemy, medicinal preparations, metallurgical operations, technical arts, the use of coins, arms and implements, &c., and the theory and practice of the transmutation of metals.

It is impossible to collect all the information on the subject of metals that this non-medieal literature in Sanskrit and Prakrit may yield. Dr. Gustav Oppert's Essay on the weapons and war implements of the Ancient Hindus, and Dr. Râjendralâl Mitra's essay on Architecture, Dress and Ornament in ancient India, Furniture, Domestic Utensils, Musical instruments, Arms, &c., in ancient India in the first volume of his *Indo-Aryans*, as well as the historical works on Indian Art (including Architecture, Sculpture and Painting) by Fergusson, Havell, Coomâraswamy, Vincent Smith, and Manomohan Ganguly casually bring before us stray evidences from the literature and secular achievements of this period. The following evidence of Mr. Schoff, in his edition of the *Periplus*, published with the object of throwing light on ancient Commercial Geography and History, tells its own tale: "Philostratus of Lemnos, about 230 A.D., mentions a shrine in Taxila in which were hung pictures on copper tablets representing the feats of Alexander and Porus. The various figures were portrayed in a mosaic of orichalcum, silver, gold, and oxidized copper, but the weapons in iron. The metals were so ingeniously worked into one another that the pictures which they formed were comparable to the productions of the most famous Greek artists."

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[1] This has been subsequently (p. 74) called the *Classical Period*—Pre-Buddhistic, Buddhistic as well as Post-Buddhistic—the age of Darsanas, Purâṇas, Kâvyas, &c. For a brief account of the literature of this period, see Sir Bhandarkar's paper in the *Journal* of the Bombay Branch of the Royal Asiatic Society, 1900, pp. 388-408.

[2] The date of Paṇini is still an open question. The nearest limit is that placed by Macdonell at about 350 B.C. Max Müller could not arrive at any decision. About a year before his death, this European savant wrote to Rai Bahadur Sris Chandra Basu, the learned translator of the *Aṣtâdhyâyi of Paṇini*: "Even Panini's date is still a riddle to me, both as to his predecessors and his successors. The date now assigned to him in the 4th cent. B.C. is useful as a working hypothesis, but no more. Perhaps you may be able to throw more light on it."

III. TANTRIC LITERATURE (from 800-1200 A.D.)

This is the period of the Empire[1] of the Pâlas in East India and Cholas in South India. The characteristic features of this period, so far as Northern India is concerned, are:

(1) in socio-religious life, the further development of Mahâyânic Buddhism, the continuation of the processes of the merging of decadent Buddhism in revived Hinduism, and the completion of the amalgamation[2] of the mythology of Śaiva-cum-Śaktaism with the doctrinal, devotional, and ritualistic machinery of the neo-Buddhistic Theogony, Cosmogony, and Theology;

and (2) in literature, the continuation of Purâṇas, and the ascendancy of *Tantras*, which, beginning in the early centuries of the Christian era (if not earlier) as hand-books of Hindu socio-religious life, gradually tinged, modified, and swallowed up the literature of the Hinduised Buddhists of the Mahâyânic school, and finally absorbed (during this period) the whole intellectual activity of the people in philosophy, religion, alchemy, and other departments of human thought. The *Tantras*[3] may in a sens be looked upon as the *Purâṇas* or *Encyclopaedia Indicas* of India on the eve of Islamisation.

The mineralogical literature of this period includes the following:—

(1) The works of Nâgârjuna (7th-8th cent. A.D ?), the founder and embodiment of Mahâyânism, and the author of alchemical Tantras.

(*a*) *Rasârṇava* gives the tests of a pure metal, treats of the extraction of Zinc from Calamine, mentions the six metals, treats of the colouring of metals, and describes an apparatus for killing metals.

(*b*) *Rasaratnâkara*[4] treats of the purification of minerals, the extraction of Zinc from Calamine, dissolution of gems, and mentions several apparatus.

(2) Vrinda's *Siddhayoga* (900 A.D.) mentions Nâgârjuna as an authority, and closely follows Charaka, Susruta, and Vâgbhata, describes preparations

[1] See Mr. R. D. Banerji's *Memoir on the Pâlas of Bengal* (L. A. S. B.), and *Gauḍarâjamâlâ*, a Bengali work, by Mr. Ramâprasâd Chanda; and *Ancient India* by Mr. Krishnaswamy Aiyangar. Dr. Rây calls this the Transitional Period.

[2] A full survey of this aspect of East Indian civilisation has been given in *Adyer Gambhîrâ*, a learned Bengali work by Mr. Haridâsa Pâlit. Portions of Mr. Pâlit's work are being rendered into English as materials for my forthcoming *Studies in Hindu Literature.*

South Indian life of this period is characterised by the rise of two new cults, Śaivaism and Vaiṣṇavism militating against and assimilating decadent Buddhism.

[3] For this second feature of the period between 800 and 1200 A.D., see Dr. Rây's resumé of authoritative opinions in the first chapter of his Introduction to *Hindu Chemistry* Vol. II: "Alchemy was included in the curricula of studies" "at the colleges in connexion with the monasteries of Pâtaliputra, Nâlandâ, Vikramasilâ, Udandapura, &c.," in East India from 5th to 12th cent. A.D. Tamil literature has yet to be studied in the same light.

[4] The enumeration of these Tantras and other alchemical works has been made in this book in an order slightly different from that in the *History of Hindu Chemistry*, as suggested by the new light thrown in Dr. Rây's Introduction to the 2nd volume.

The division into periods of mineralogical literature has also been modified in this book to suit its requirements. Dr. Rây's division into Tantric and Iatro-chemical periods in the 1st Edition of the First Volume was certainly a tentative one.

in which Sulphide of Copper and Æthiops mineral figure and also a process of killing iron.

(3) Chakrapaṇi[1] Datta's medical treatise (1050 A.D.), written at Gauda during the period of the ascendancy of the Pâlas, liberally recommends compounds of metals as medicinal drugs, treats of the black sulphide of mercury, powder of copper compound and a process of killing iron.

(4) Govindabhâgavat's *Rasahridaya* (11th century), written at the request of the king of Kirâta land, *i.e.*, the region adjoining modern Bhutan, mentions the six salts, the noble metals, essential metals, &c., and treats of the properties of metals.

IV. Modern Literature (13th cent.– 16th cent.)

This is the period :

(1) in politics, of (*a*) the gradual establishment of Islam as a power and the foundation of Moghul Imperialism, (*b*) small independent Hindu kingdoms, especially the kingdom of Vijayanagara, the "Forgotten Empire" of the South, which presented a formidable bulwark against the inroads of the new power, and (*c*) the advent of the Portuguese ;[2]

(2) in socio-religious life, of (*a*) aggressive Islam accelerating the further fusion of Hinduism and Buddhism, and calling forth the assimilative and adaptive capabilities of the people of India, and (*b*) the rise of new cults in all the four quarters of India ;

and (3) in literature, of (*a*) the continuation of Purâṇas, Tantras and other Sanskrit works, and of (*b*) the growth and development of new languages and literatures embodying the aspirations of Kavira, Nânaka, Tukârâma, and Chaitanya—the founders of the new age.

The following Sanskrit works mentioned by Dr. Ray may be placed during this period:[3]

(1) *Rasendra Chuḍâmaṇi* (12th—13th cent. A.D.) of Somadeva gives tests for killed iron, treats of the residues from lead and tin, and describes the apparatuses.

(2) *Rasaprakâsasudhâkara* of Yasodhara (13th cent.) describes the extraction of zinc from calamine and a process for the fabrication of gold.

(3) *Rasakalpa* (13th cent.) describes the six metals, minerals and the processes of killing them. The author says, "I have performed the experiments with my own hands, and have seen them with my own eyes. They are not recorded from mere hearsay or from the dictation of a teacher."

(4) *Rasa Sâra* (13th cent.) of Govinda acknowledges its indebtedness

[1] Sanskrit Text edited by Kavirâjas Sen (Calcutta).

[2] "The political influence of the Portuguese as early as 1533 A.D. is evident from the fact that Sultan Bahadur, King of Gujrat, entered into a treaty with them."—*Memoirs of Hindusthan.*

[3] The sub-divisions of this epoch into Tantric and modern according to the *History of Hindu Chemistry* have not been adopted here. The treatises also have been slightly re-arranged. Vernacular Literature of these four centuries remains yet to be ransaked for a more complete picture of the secular life of the Hindus.

to the Buddhists of Tibet, is a comprehensive, but purely chemical work dealing with 18 operations on Mercury.

(5) *Rasaratna-Samuchchaya*[1] (13th—14th cent.) contains elaborate treatment of mercury, copper, pyrites, extraction of zinc and copper, sulphur, cowries, gems, processes of reducing gems to ashes, the pure metals, the metals which emit a fœtid odour, and alloys, the laboratory and the accessories.

(6) *Rasarâjalakṣmi* (14th cent.) of Viṣnudeva, court physician to King Bukka of Vijayanagara, mentions the common mineral salts.

(7) *Rasanakṣatramâlikâ* (14th cent.) of Mathana Simha, court physician to the king of Malwa, liberally recommends mineral preparations and mentions opium as a drug.

(8) *Rasaratnâkara* (14th cent.) of Nityanâtha quotes Nâgârjuna, Chakrapâṇi, and *Rasendrachuḍamaṇi*.

(9) *Sârṅgadhara-Saṃgraha* (1363 A.D.), written at Chitor under the Chauhans, treats of the purification and incineration of *seven*[2] metals, but does not mention zinc, has been quoted by Bhâva Misra.

(10) *Dhâturatnamâlâ* (14th cent.), by Devadatta of Gujrat, is "devoted exclusively to short processes of killing metals and minerals. Six metals are recognised at the outset, but later on *Kharpara*,[3] which is the mineral calamine, is taken as synonymous with jasada or zinc."

(11) *Nighantu*,[4] by king Madanapâla of Kanauj (1374), mentions the metals as drugs, among which there is zinc or jasada.

(12) *Rasapradipa* (16th cent.) describes a detailed process for the preparation of mineral acids and mentions the remedy for the Portuguese disease called Syphilis (Phiringiroga), is quoted by Bhâva Misra.

(13) *Dhâtukriyâ* (16th cent.) mentions the country of the Phiringis as well as Ruma (Constantinople), enumerates the metals, gives their synonyms and localities, mentions zinc, and speaks of 'imitation gold,' by which one can enrich oneself.

(14) *Bhâvaprakâśa*[5] (after 1535, about 1570 according to Dr. Wise) mentions new drugs, and the Phiringiroga, and recommends mineral preparations as drugs, greatly eclipsing the vegetable.

(15) *Râjanighantu*[6] (17th cent.) of Narahari Pandit, has a chapter called *Suvarṇâdivarga*, and mentions the minerals, treating of their medicinal effects.

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[1] See the Text published by the Anandâsrama Office, Poona (1901), pp. 22-34, or the Extracts in Dr. Rây's *Hindu Chemistry*, Vol. I.

[2] "From the time of the Susruta to that of the Rasaratna-Samuchchaya we find all along *six* metals. * * * In the medical lexicon ascribed to king Madanâpâla and written about 1374 A.D., Zinc is distinctly recognised as a metal under the designation of Jasada." *Hindu Chemistry*, Vol. I, First Edition, p. 86. Sukranîti mentions *seven* metals and two alloys.

[3] "Zinc is not mentioned by the older writers, such as Susruta"—Dr. Dutt. See the chapter on Zinc in his *Materia Medica*.

[4] See the Edition of Pandit Jivânanda Vidyâsâgara (1875), pp. 50-56, Chapter IV.

[5] See Dr. Dutt's Preface to his *Materia Medica* (1877).

[6] See the Hindi Edition (1889) published from Benares, pp. 129-142.

SECTION 5.

History of Hindu Mineralogy.

(*b*) *Literature on Gems.*

The preceding survey, though scrappy and inadequate, must have made it clear that the Hindu literature on metals has grown mainly round the practical arts connected with industry, medicine and alchemy. The literature on precious stones also has developed through the same circumstances, and has had a similar history.[1] It is to one or other of the several epochs in the growth of this metallurgical, medicinal, and alchemical literature on gems that the portions of *Sukraniti* dealing with these topics have to be referred. We, therefore, proceed to give a brief history of this literature.

The knowledge of the use of gems has, like that of the metals, been discovered in almost all the branches of Hindu literature, and, therefore, may be conveniently grouped for historical purposes under the same epochs as those for metals. Besides the treatises mentioned above which are common to both metals and gems, there are special treatises which have to be noticed here in connexion with gems. The chief difficulty in the classification into epochs lies, as always in Indian historical problems, in chronology. The dates have been in most cases conjectural.

We have noted above that Dr. Tagore's encyclopædic work on gems has drawn upon sixty-four Sanskrit treatises. Dr. Râmdâsa Sen's work in collaboration with Pandit Kâlivara Vedântavâgisa is based on *Brihat Samhitâ*, *Mâṇiparikṣa*, *Sukraniti*, *Mânasollâsa*, *Amaraviveka*, *Hemchandra-kosa*, *Muktâvali*, *Râjanighantu*, *Agnipurâṇa*, *Garuḍapurâṇa*, *Agastyamatam*, and *Ratna-Samgraha*. Another important work on the subject is *Yukti Kalpataru*[2], which is in manuscript, but has been used by Prof. Yogesh Chandra Roy in his *Ratnaparikṣâ*.

Fully conscious of the chronological defects, we add here a short history of the literature on gems in the Indian world :

I. VEDIC PERIOD

Precious stones and jewels are mentioned in Vedic literature. " Maṇi is the name in the Rigveda[3] and later of a jewel used as an amulet against all kinds of evil. That either pearl or diamond is denoted is not clear. * * The Maṇi is certainly worn round the neck." "In the Brâhmaṇa of the old recension of

[1] The meagreness of this summary would be evident from the facts that (i) it has not been possible to gather information from even the most important works of non-Ayurvedic Sanskrit literature ; (ii) ancient Tamil literature has been wholly excluded, and (iii) old Prâkrit and vernacular works also have not been touched.

[2] Like the *Brihat Samhitâ* of Varâhamihira (6th cent. A.D.), this work ascribed to Râjâ Bhoja (probably 11th cent.) is a valuable repository of information regarding things Indian. One manuscript of this work belonging to Mahâmahopâdhyâya Pandit Adityarâma Bhattâchâryya , M.A. of Allahabad is in the library of the *Panini Office* and is being edited with translation and notes for the *Sacred Books of the Hindus Series* by the present author.

[3] Macdonell and Keith's *Vedic Index*, vol. II. pp. 119-120. See also pp. 304, 350.

the *Yajurveda* jewellery[1] is recommended to be strung on gold." The *Atharva-Veda* in Harvard Oriental Series bears the following testimony: "The bit of Hindu folk-lore about the origin of pearls by transformation of rain-drops falling into the sea * * * * is at least ten centuries old. Born in the sky, ocean-born, brought hither out of the river, this gold-born shell[2] is for us a life-prolonging amulet."

II. Classical Period[3] (800 B.C.—800 A.D.)

1. *Charaka* mentions gems as drugs appertaining to the earth, and gives a formula of 'the powder of pearl' compound.

2. *Susruta*[4] mentions pearls, vidruma, diamond, vaiduryya, sphatika (quartz) and other gems as cool and being antidotes to poison and useful in ocular diseases.

3. The Epics and Purâṇas refer to precious stones as ornaments for buildings, palaces, and images. The court of Yudhisthira, the cities of Dwârakâ and Ayodhyâ, the chariots, umbrellas, temples, &c., all testify to the use of emeralds, beryls, rubies, &c. We also read of gifts made in diamonds, pearls, corals and rubies, and also of plants, cows and hills made of gems.[5] The Mahâbhârata has often referred to *vaiduryya, vidruma, sphatika, suryya-kânta, chandrakânta, indranila, padmarâga, diamond* and *marakata.*

4. *Brihat Samhitâ*[6] of Varâhamihira (505-587 A.D.) has four chapters on the examination of gems, refers to many previous *Ratnasâstras*, describes the characteristics of 22 gems, considers five of them only to be principal, begins the section on diamonds thus: "A good gem brings prosperity to the king, and a bad one brings misery. It is, therefore, necessary to examine the properties of gems with the help of persons learned in the science."

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[1] Mitra's *Indo-Aryans*, Vol. I, p. 230.

[2] *Atharva-Veda* in Harvard Oriental Series, Vol. I, pp. 161-162.

[3] This would include some of the Upanişads, the systems of philosophy, the epics, the literature of the precursors of Charaka and Pânini as medical men and grammarians, the literature of Buddhism, both Hinayâna and Mahâyâna, the Kâvyas and other products of Vikramadityan era, the more important Purâṇas, and some of the Tantras. See the volumes on the History of Sanskrit Literature by Max Müllor, Macdonell, Weber, and Horrwitz. Max Müller's volume was long out of print, but has been recently published by the Panini Office, Allahabad. See also the paper on *the Character and Origin of the Puranas* by Mr. B. C. Mazumdar in the *Modern Review* (Calcutta), Vol. XI, pp. 72-79, and *the Dynasties of the Kali Yuga* by Pargiter (Oxford University Press, 1913).

[4] See p. 268 of the Bengali translation of *Susruta* by Kaviraja Devendra Nath Sen.

[5] Prof. Yoges Chandra Roy's Bengali work as well as Tagore's *Manimâlâ*.

[6] See Chidambram Iyer's *Brihat Samhitâ* (1884), pp. 104-174. This work introduces us to the meteorological, agricultural, zoological, architectural, medicinal and astronomical ideas of the Hindus in the 5th and 6th centuries A.D., and "is one huge attempt to interpret the language of nature and ascertain its bearing on the fortunes of men and nations." Those who are interested in the influence of Geography on History will find this ancient Hindu scientist partially anticipating Bodin, Montesquieu, Hegel, Buckle and Bagehot by full one thousand years.

III. PÂLA-CHOLA OR TANTRIC PERIOD (800-1200 A.D.)

1. *Rasaratnâkara*[1] of Nâgârjuna (8th cent.), the Mahâyânist, treats of the extraction of the essence of vaikrânta, dissolution of gems (pearls, &c.), killing of diamond.

2. *Agnipurâṇa* (9th cent.) testifies to Tantric influence, treats of the examination of gems, enumerates 36 precious stones, describes 8 only as Mahâratnas.

3. *Garuḍapurâṇa* (9th cent.) testifies to Tantric influence, also treats of the examination of gems and enumerates them, mentions Turkey, considers 12 gems as principal, discusses the features to be noticed in a gem before estimating value.

4. *Agastyamatam* (later than Garuḍa, but previous to Viṣṇudharmottara) mentions Arab and Turkey, enumerates ten gems, recommends the use of nine gems for the propitiation of nine planets, is quoted in *Yukti Kalpataru*, mentions pushparâga, vaiduryya, gomeda, sphatika (quartz), and pravâla as five *uparatnas*, or inferior gems, notices the aspects to be noted in a good gem.

5. *Viṣṇudharmottarapurâṇa* (10th cent.), really a part of Garuḍapurâṇa, bases its enumeration of precious stones on the *Agnipurâṇa* and examinations of them on the *Garuḍa*, mentions nine gems[2] as mahâratna.

6. *Jyotiṣaratnamâlâ* of Srîpati, the astronomer (10th cent.), enumerates the same nine gems as sacred to the nine planets that are mentioned in Sukranîti.

7. *Matsyapurâṇa* describes a huge lake with diverse gems, in its 128th chapter.

8. *Yukti Kalpataru* (11th cent.) quotes Garuḍapurâṇa and Viṣṇudharmottarapurâṇa as authorities, is similar to Agastyamatam in certain particulars regarding the examination of gems, gives technical terms used in *Ratna Sâstra*, treats of " horses, elephants, ornaments, flags, umbrellas, seats, ministers, ships," etc., besides jewels, and frequently quotes from an author of the name of Bhoja, mentions mâṇikya, vajra, vidruma, gomeda, muktâ, vaidurryya, indranîla and marakata as the eight principal gems.

9. *Ratnasangraha*[3] of Maharsi Simha (12th cent.) consists of only 21 slokas, but gives a brief description of all the gems, refers to the prosperity of Yavanas, does not mention vidruma.

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[1] Dr. Rây's *Hindu Chemistry*, Vol. II, pp. 8-9.

[2] According to Sukranîti the Mahâratnas are nine in number. About nine gems as favourites of nine planets, see sloka 21 of Adhyâya 2 of *Jâtaka Pârijâta*, translated by Subrahmaṇiya Sâstri and printed at Nirṇaya Sâgar Press, Bombay (1903), p. 24.

[3] Edited and published by Dr. Sen together with his Bengali monograph on precious stones.

IV. Modern Period (1200-1600 A.D.)

1. *Rasara-tnasamuchchaya* (13th-14th cent.?) mentions vaikrânta,[1] enumerates 27 sages skilled in alchemy, among whom Vyâdi[2] is one, enumerates and describes the gems as agencies which help the fixation or coagulation of mercury, treats of the process of reducing gems to ashes.

2. *Dhâturatnamâlâ* (14th cent.) treats of the properties of pearls, coral, diamond, and the modes of their incineration.

3. *Nighantu* of Madanapâla (14th cent.) has a few verses about gems also.

4. *Dhâtukriyâ* (16th cent.) gives the synonyms of pearls, coral, etc.

5. *Bhâvaprakâśa* (16th cent.) also refers to gems, discusses their effects as drugs, enumerates several new uparatnas or inferior gems.

6. *Râjanighantu* (17th cent.) recommends the use of gems for the propitiation of planetary deities[3], indicates Tantric influence, and treats of their medicinal effects.

From the foregoing history of mineralogical literature of the Hindus extending over 2,500 years, it would have been evident that there are two features which characterise it:—

(1) that it is a record of continuous growth: Indian mineralogical literature does not present the case of an arrested development but has grown from epoch to epoch, utilising and assimilating the new conditions[4] according to the changes in the cultural environment of the country, and displaying novel features according to the altered circumstances of the times.

(2) that, like every other branch of Hindu culture, it has been built up by the joint and cumulative effort of the people of the whole of India: Punjab, Gujrât, Râjputânâ, Madhyadesa, Bengal, Mahârâstra and Dâkṣiṇâtya. Each quarter has contributed to the growth and development of Indian mineralogical literature, according to its opportunities, by supplying either 'great masters' or commentators as the need arose. Thus among the heroes of Hindu medicine and mineralogy, Charaka belongs to the Punjab, Susruta is claimed by Punjab as well as Benares, Vâgbhata belongs to Sindh (Western India), Vrinda to the Deccan, Narahari Pandit is claimed by Kashmir, but belongs probably to Mahârâṣtra, Chakrapâṇi to Gauḍa (Bengal), Sârangadhara to Râjputânâ, Viṣṇudeva to Vijayanagara, Devadatta to Gujrât, Madanapâla to Kanauj, Mathanasinha to Malwa, and Bhâvamisra to some part of Madhyadeśa (*i.e.* the U. P.).

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[1] Prof. Yoges Chandra considers this to be the first mention of vaikrânta. But the discovery of Nâgârjuna's *Rasaratnâkara* has pointed to it some four or five centuries earlier.

[2] This Vyâdi has been mentioned in Gâruḍapurâṇa as specialist in detecting artificial pearls.

[3] See the Hindi Edition (1883), p. 130-142. Published from Benares.

[4] For the 'original' features in the successive works of the so-called commentators, see the account of Sanskrit medical treatises in Kavirâja Birajâcharaṇa Gupta's Bengali work, *Vanauṣadhidarpaṇa* (Auddy Co, Calcutta, 1908), pp. 30, 33, 34, 35, 36. In this the author has presented a learned treatment of the History of Hindu medical literature, and has discussed the questions of priority, interpolations, &c., by reference to original texts.

SECTION 6.

General remarks on Metallurgy[1] *in Hindu life and thought.*

We shall first mention all the references in *Sukranîti* bearing on the subject of metals, whether (1) as indicating metallurgical, alchemical, medicinal or artistic and commercial uses made of them by the ancient Hindus or (2) as indicating their theoretical or scientific knowledge about the diverse properties of metals and their uses in society. A study of these references will give us (1) an estimate of certain aspects of the material civilisation of the Hindus, (2) an idea of the geographical influences in which portions of the work might have been composed, and (3) incidentally enable us to determine the age of certain parts by comparison with the other works on the subject, as described in the preceding section.

It may be remarked here that the "distribution" of the mines, metals, stones and gems mentioned in *Sukraniti* covers practically a chapter of the whole Economic Geology of Ancient and Mediæval India. The Himâlayan regions, Burma, Râjputana, the Deccan and the Indian ocean are the principal localities from which the minerals were derived in those days. Some of these regions have been identified, others not. It would appear that commercial intercourse was sufficiently active in promoting the formation of all-India 'markets,' or rather "world-markets" for the valuables. It is therefore very difficult to give a 'local' character to the mining and allied topics referred to in *Sukranîti.*

Extent and Importance.

On this subject of mining[2] in ancient India, the *Arthasâstra* of Kautilya is a fuller and more definite document than the work of Sukrâchâryya. The economic and financial condition of the Maurya times (4th—3rd cent. B.C.) is vividly mirrored forth in this treatise. "According to it, there were two classes of mines, *viz.* (1) ocean-mines and (2) land-mines. * * * The duty of the Superintendent of ocean-mines was to look after the collection of diamonds, and other precious stones, pearls, corals, &c. * * * The Superintendent of land-mines had to perform the difficult work of prospecting and discovering new mines on plains and mountain slopes. * * * Silver ores are those which have the colour of *sankha* and do not emit much foam and smoke. Similarly, we find mentioned the properties of the ores of gold, bitumen, copper, lead, tin, iron, &c. * * * The Brahmana who has committed heinous offence * * * may be condemned to the mines."

The fables and fairy legends[3] in which gold, silver and precious stones play an important part also tell their own tale. In the appendix to his

[1] Birdwood's *Paris Universal Exhibition of* 1878, pp. 20-69 (2nd Edition).

[2] See the paper on *Some Glimpses of India in the age of Chandragupta* by Mr. Narendra Nath Law, M.A., B.L., in the *Modern Review* for April, 1911.

[3] See also Lalbehari Day's *Folk Tales of Bengal* (MacMillan & Co.) and Shaikh Chilli's *Folk Tales of Hindusthan* (Panini Office, Allahabad) for the stories, respectively, regarding the origin of rubies, and of the Seven Goldsmiths.

Indian Mythology[1] Mr. Fausboll remarks : "In all cases the greater part of the Folk-Tales, both on the whole and in many separate characteristics, point back to India[2] as the land of their birth. ° ° ° And when the old Greek authors Herodotus, Ktesias, Strabo and Ælian speak of gold-digging ants ° ° ° it is evident that these tales are only a reflection of the imaginative mind of India. Some of the principal elements in the fables are gold, silver and precious stones. ° ° ° In India we read of serpents (nâga, sarpa) in ant hills full of gold (Panchatantra III, 5,10), of golden hamsas (Panchatantra III, 6, Jâtaka Nr. 136), of the Nâga who makes a present of jewels to the king who saved its life (Jâtaka Nr. 386), of the princess who will only marry one who has seen the golden city (Kathâsarit Sâgara V, 24), of the golden lotuses (K. S. S. V, 25), of Śiva's garden, of golden trees with branches of jewels and flowers and with clusters of pearls (K. S. S. IX, 52), and so forth.

How does it happen that precious metals and minerals play so important a part in India's tales (and therefore also in those originating from there) ? The simple reason is because India has always been richly endowed with the same.

An early proof of this fact we gather from the records of the ancient Greeks. Thus whilst Megasthenes relates that, whilst the land on its surface bears all kinds of cultivated fruits, it has underneath numerous veins of all sorts of metals, for it is in possession of much gold and silver, and not a little copper and iron, yea, even tin and other metals which are used in the manufacture of useful articles and ornaments, as well as implements of war. He further says that Taprobane (Ceylon) produces more gold and more large pearls than the continent of India, and people's raiment is interwoven with gold and ornamented with gems.[3] ° ° ° Another proof is the numbers of mines still being worked in India. According to Constable's Hand Atlas of India there are about 59 gold mines, 14 silver mines, 34 diamond mines, besides 105 iron, 55 copper and 21 lead-mines. The great conquerors whose desire it was to reach India also give evidence of this. ° ° °

Considering these things, can we wonder that we in India find a God of Riches (Kuvera), a god for those riches that grow in the mountain and not those that grow in the fields ?

Precious stones and metals have also left their indelible marks on the Tamil classics of the Augustan age which, according to Mr. Aiyangar, should be placed in the 2nd century A.D. Two celebrated classics, the *Silappadhi-Kâram* (epic of the Anklet) and *Manimekhalai* (Jewel-belt), which incidentally bring before us a vivid picture of the political, religious, educational, economic and social life of the early Cholas, derive their titles, *dramatis personæ*, scenes and incidents from the morals and manners of people dealing in gold, rubies and jewels.

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[1] Luzac and Co., London, 1903, pp. 189-93.

[2] Benfey's Translation of *Panchatantra.*

[3] See footnote on p. 192 of *Indian Mythology.*

The author of the *History of Indian Shipping* quotes the following from "A geologist's contribution to the History of Ancient India" by Prof. Ball in the *Indian Antiquary* for August 1884 : "Even in the Mosaic Period (1491-50 B.C.) precious stones which were to a great extent a speciality of India appear to have been well known." Prof. Ball also rejects the view held by Lassen, Heeren and others that gold (and silver) was not indigenous to India but was imported from abroad, *e.g.*, Tibet, Burma, and Africa.

The following evidence given by Mookerji derived from Seal's *The Chemical Theories of the Ancient Hindus* gives a bright picture of the economic mineralogy of Hindu India : "Broadly speaking, there were three great discoveries in applied chemistry to which India owed her capture of the world-markets : (1) the preparation of fast dyes for textile fabrics by the treatment of natural dyes like *manjistha* with alum and other chemicals ; (2) the extraction of the principle of indigotin from the indigo plant by a process, which, however crude, is essentially an anticipation of modern chemical methods ; and (3) the tempering of steel in a manner worthy of advanced metallurgy, a process to which the mediæval world owed its Damascus Swords."

Ornaments.

According to authors of the Sukra-cycle, as to all Hindu writers, the Earth is full of wealth,[1] and Kuvera[2] is the deity presiding over it. They appreciate *Kuveratâ*[3] or the possession of wealth more than many other qualifications, though, of course, it is inferior to *Îsatâ* or over-lordship, *i.e.*, sovereignty. They would therefore enjoy the good things of this world and advise others to do it.

According to them ornaments constitute some of the important valuables[4] of the state, and the ruler should appoint females to look after them. These are some of the items among the gifts[5] of the king to his officers, and we are told that the good servant[6] is satisfied with those that he receives and does not hanker after things not given. The love of ornaments among Sukra's countrymen is also indicated by the frequent metaphorical[7] uses of the term in *Sukranîti.* Thus "the ornament, the kingdom, strength, learning, or wealth does not adorn a man so much as courtesy and gentleness. Speed in horses, splendour in jewels, mercy in kings, blandishments in prostitutes, sweet voice in singers, charity in rich men, prowess in soldiers, abundance of milk in cows, restraint in ascetics, eloquence in learned men, impartiality in councillors, truthfulness in witnesses, devotion in servants, good counsels in ministers, silence in fools, faithfulness in wives, are the proper ornaments."

Three uses of ornaments have been mentioned in the treatise :—(1) as valuables of the treasury and as marks of honour conferred on office-bearers, as we have just noted; (2) as decorations for the person of females ;—"The woman should put on clothes, ornaments, jewels given[8] by the father-in-law,

1 Sukra I, 340-350, 357-358.
2 Sukra I, 151, 160, 301-302.
3 Sukra IV, iii, 4-5.
4 Sukra I, 703-704.
5 Sukra II, 846-848.
6 Sukra II, 12.
7 Sukra III, 291-292, 471-479.
8 Sukra IV, iv, 21-22.

mother-in-law, husband, parents, brothers, uncles and relatives ;" (3) for adorning images of the *râjasika*[1] type. That ornaments are important items in the material life of the people is likewise shown by the distinct recognition of the social offence committed by those who use others' clothes, ornaments[2] gold, &c.

The following is taken from Râjendralâl's *Indo-Aryans* :--" In the *Nirukta* of Yâska and the grammar of Pâṇini not only ornaments, but names of various kinds of them are enumerated, and Manu defines the nature and duties of the caste whose special vocation was to manufacture them, and the punishment meet for fraudulent adulteration of gold. The old vocabulary of Amarasinha gives names for crowns, crests, and tiaras for the head, of rings, flowers and bosses for the ears; of necklaces of one to a hundred rows, and of various shapes and patterns; of armlets and bracelets ; of signet and other rings for the fingers ; of zones and girdles for the waist of both men and women ; as also of ornaments of bells, bands and chains for the legs and ankle." The sculptures of Bhuvaneswara and the bas-reliefs of Sânchi and Amarâvati exhibit specimens of a great variety of ornaments which have been described with illustrations by Râjendralâl.

The countrymen of Sukrâchâryya are thus neither barbarous people who do not understand the importance of valuable commodities and who have not the æsthetic sense to appreciate them as materials for decorative and utilitarian arts. Nor are they the Utopians who set no store by precious metals, but employ gold and silver for their vessels of baser use. We know that the Utopia or 'Nowhere' of Sir Thomas More is peopled by men among whom the wearing of gold is a reproach and where fetters of bondmen are made out of it. "Gold and silver, whereof money is made they do so use as none of them doth more esteem it than the very nature of the thing deserveth. And then who doth not plainly see how far it is under iron: as without the which man can no better live than without fire and water. Whereas to gold and silver nature[3] hath given no use, that we may not well lack : if that the folly of men had not set it in higher estimation for the rareness' sake. * * * And these metals, if they should altogether at once be taken from the Utopians no man there would think that he had lost the worth of one farthing."

These are the teachings of the socialistic and the political reformer of England in the 16th century. But the authors of the Sukra cycle are not revolutionary idealists running away from the troubles and imperfections of the existing state of things into an Ideal Republic of nowhere. They are sane men dealing with the world as it is, and have to recken with the human passions as they are. They therefore do not taboo wealth and enjoyments from their scheme of life, but try to regulate them as far as necessary.

1 Sukra IV, iv, 163-164.

2 Sukra IV, v, 151-152.

3 See the chapter on "journeying or travelling abroad with diverse other matters cunningly reasoned" in the *Utopia* of Sir Thomas More (English translation).

Sukra on Mining and Metallurgy.

In this pursuit of wealth they do not scruple to disembowel the "unsunned" treasures of the underground universe and search its entrails wide and deep. It is because of this that we have the very old European tradition about the 'wealth of Ind' in the gorgeous east which "with richest hand showers on her kings barbaric pearl and gold." Mining becomes thus one of the occupations of the people, and the rulers have a right to its yield. Among other functions the *Sumantra*[1] or Finance Minister of the state has to study the amount of revenue realised through mines. This income from the mines is known to be *Itara* or other than *pârthiva* (*i.e.*, terrestrial), according to the Public Finance of the Sukra statesmen. "[2] Duties, fines, royalties on mines,[2] prices and contibutions, etc., are known to constitute non-terrestrial income according to writers and specialists." The mention of mines[3] among the regions of Sulka or duty which is the king's share from the buyer and the seller points also to the importance of mining as an item that feeds the Income-schedule of the State Budget. So we read: "The king should realise from minerals[4] at the following rates: half of gold, one-third of silver, one-fourth of copper, one-sixth of iron, tin and lead, half of gems, half of alkalies; after the expenses have been met." The ruler is also advised to appoint miners[5] to their proper works and store by minerals[6] carefully for emergency or other purposes.

Not only the miners, but goldsmiths, coppersmiths and other metal-workers as well require patronage and "protection" of the State. "The king should always keep in his kingdom the tools and implements of the metal-workers[7] after inspecting them" and find occupation for "those who make lighter machines, gunpowder, arrows, cannon-balls, and swords, and construct various tools and implements, arms and weapons, bows and quivers, etc.; those who prepare ornaments of gold, jewels, etc., builders of chariots, stone-carvers, blacksmiths, and those who enamel metals."

This enumeration of the industries connected with metallurgy to be encouraged by the king involves also a good deal of legislation on the subject. Thus among the laws to be promulgated among the people one is that "falsehood must not be practised by anyone with regard to the standard of

[1] Sukra II, 211-212.

[2] Sukra II, 671-672. The *pârthiva* or terrestrial income accrues from the rights of sovereignty over lands, rivers, seas, lakes, tanks, wells, &c.

[3] Sukra IV, ii, 212-213.

[4] Sukra IV, ii, 233-235. Here I beg leave to correct my translation on p. 148 of Vol. XIII, Parts I and II of the Sacred Books of the Hindus Series. *Vanga* is tin and not zinc. The words for zinc in *Sukraniti* are *rangaka* and *jasada*. The reader is requested to understand these three lines as translated in this section.

[5] Sukra II, 404-405.

[6] Sukra IV, ii, 60-63.

[7] Sukra IV, iv, 85-87.
Sukra II, 394-398.

weights and measurements, currency, some kinds of metals[1] etc." So also "the man who adulterates[2] metals deserves double the punishment." State intervention in Industry cannot be one-sided. If it is the duty of the ruler to maintain the artists and artiṣans and thus "protect" them with work and wages, it is also his lookout to see that the people should be protected *from* them. Hence guardianship of the state must be exercised against the dangers of false and counterfeit coinage and the passing off of base metals for genuine and high class commodities.

An account of the fabrication of imitation-jewellery in Hindu India has been preserved in the dramatic literature of the 1st cent. B. C. In the *Troy Cart* of Ṣudraka a question is raised about the identity of certain ornaments produced in a court of justice. We quote the following from that play published in Wilson's *Hindu Theatre*:[3]

"*Judge.*—Do you know these ornaments?

Mother.—Have I not said? They may be different, though like. I cannot say more; they may be imitations made by some skilful artist.

Judge.—It is true. Provost, examine them; they may be different, though like; the dexterity of the artists is no doubt very great, and they readily fabricate imitations of ornaments they have once seen, in such a manner that the difference shall scarcely be discernible."

The examination of metals as to their genuineness and worth thus becomes an important function of the state as well as people. The Sukra statesmen know very well that metals[4] may be made to acquire artificial character, and have mentioned the preparation of artificial gold[5] as an art or one of the sixty-four *kalâs*. The testing[6] of minerals must therefore be an important branch of learning and is referred to as a *kalâ*. And the wise men[7] are those who know how to determine their value by carefully examining them. One test is given in the following lines: "If two pieces[8] of a metal—one pure and the other suspected

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[1] Sukra I, 587-592.

[2] Sukra IV, v, 660. So also Manu advises the king to cause a dishonest goldsmith to be cut to pieces with razors. IX, 292.

[3] Wilson's *Hindu Theatre*. II, p. 85.

[4] Sukra IV, ii, 171-172. where we are told that gems also have defects, but they are 'natural.' This preparation of artificial metals, however, does not seem to be the transmutation of "base" metals, *e.g.*, copper or lead into gold or silver, but the manufacture of imitation gold or silver, *i.e.*, of substance having their lustre, or the laying of gold or silver deposits on copper and other metals. Prof. Yoges Chandra Ray proves this in his *Ratna-Parikṣâ* by examining the extracts from *Rasaratna-samuchchaya* and *Garuḍa-purâṇa*.

[5] Sukra IV, iii, 178. This does not refer to the alchemical transmutation of base metals into gold, but the manufacture of imitation gold.

[6] Sukra IV, iii, 180.

[7] Sukra IV, ii, 171-172.

[8] Sukra IV, ii, 178-179. Specialists would do well to examine the accuracy of this test in a laboratory.

as alloy—be successively passed through the same hole, and threads of equal lengths be drawn out of them and weighed, and if the weights of both are equal, then the metal[1] is unalloyed, otherwise not."

We have already referred to some of the industries connected with metal-work.[2] The use and manufacture of seals and emblems have been mentioned in several places.[3] Thus, "one should put on the clothes, uniforms and emblems granted by the king;" "they should put down their seals over it at the end of the writing;" "the king should give to each cultivator the deed of rent having his own mark (seal)." These and other manufactures are suggested also in the enumeration of the *kalâs, e.g.,* (1) melting,[4] powdering, incineration &c., of metals, (2) the knowledge of the mixtures of metals and herbs or medicinal plants, (3) analysis and synthesis of metals, (4) preparation of alloys, (5) alkalies and salts; (6) cleansing, polishing, (7) dyeing of stone and metal vessels, (8) making of ornaments, (9) enamelling, (10) preparation of tools and implements, &c."

Metals thus occupy a very important place in several aspects of the secular life of the people as described in *Sukranîti.* They have a religious bearing also. For the "images of gods[5] are made of sands, pastes, paints, enamels, earth, woods, stones and metals," the strongest being those of metals. This religious branch of the metal-craft carries with it a very severe responsibility. It compels the artist to be very particular about his workmanship and to study the canons of Hindu art, in order to conform to them as closely as possible. For, though defects may be allowed in images of a temporary character, *e.g.,* those made by painting, drawing, or of sand, earth &c., and in the natural images of gems and stones picked up in rills and hills, those which are to be durable must be tested very minutely and must satisfy the condition of good Art. Thus we are told that "one should consider the defects of proportion in images of stones[6] and metals only." If the sculptor bungle with the work entrusted to him and do not construct the image according to the prescribed measurements of the limbs, his wealth and life would bejeopardised and his misery[7] will daily increase.

Metals and stones in minor arts.

We thus see that, besides the important part played in commercial, social, religious, and literary lives of the people of India, the metals and gems have had their influence on Indian art also. Architecture as well as sculpture of Hindusthan bear abundant testimony to the treatment of *dhâtus* and *ratnas* by artists.

[1] See also the rule laid down in *Sukraniti* about the relation between weight and volume. IV, ii, 177.

[2] Notice also the references to the manufacturers of badges, sceptres, bridges, coins, &c., Sukra II, 853-855; I, 722.

[3] Sukra II, 490-401; II, 739-740; IV, ii, 247.

[4] Sukra IV, iii, 145-150, 167-168, 170-193.

[5] Sukra IV, iv, 147-151.

[6] Sukra IV, iv, 305-309.

[7] Sukra IV, iv, 157-159.

In their historical works Fergusson, Râjendralâl, Havell, Vincent Smith, and Manomohan Ganguly have sufficiently noted the manipulation of metals and gems in Hindu art. The tenth chapter of Vincent Smith's work, that on Hindu minor arts, deals, among other things, with the following topics relevant to the points discussed here: (1) coinage, (2) gems, seals and jade, (3) jewellery, (4) reliquaries and gold images, (5) silver pateræ and bowls, (6) copper-vessels.

The use of metals for the fabrication of domestic vessels in Hindu India is thus described by Dr. Râjendralâl in the paper on *Furniture, Domestic Utensils* etc., in *Indo-Aryans*, Vol. I:—"The Rig-Veda alludes to golden cups; The Sutras and the Mahâbhârata frequently refer to vessels of other than gold and clay. Tvâshta, the Vulcan of the Hindu pantheon, was the most celebrated artificer of metallic arms, but the Ribhus greatly excelled him in the formation of sacrificial vessels of wood and metal.

In a mediaeval work, the *Kâlikâ Purâṇa*, plates made of gold, are described to remove excesses of the three humours, and promote the strength of vision; those of silver favourable to vision and inimical to bile, but calculated to increase the secretion of wind and phlegm; those of bronze, agreeable and intellectual, but favourable to undue excitement of blood and bile; those of brass, wind-generating, irritating, hot, and heat-and-phlegm-destroying; those of magnetic iron, most beneficial in overcoming anasarea, jaundice and anæmia. The *Yuktikalpataru* recommends that drinking cups for royal personages should be made of gold, silver, crystal or glass."

The *Periplus* describes Muziris, a port on the Arabian coast, whence Romans used to carry pearl, ivory, diamonds, rubies, topazes, stibium, coral, flint, glass, brass, arsenic and lead. Mr. Aiyangar in his *Ancient India* quotes the Tamil classic *Ahanâ-nûru* to prove the flourishing condition of "Musiri to which come the well-rigged ships of the Yavanas."

SECTION 7.

The Doctrine of Seven Metals.[1]

Sukranîti mentions seven metals *viz.*, suvarṇa (gold), rajata (silver), tâmra (copper), vanga (tin), sîsa (lead), rangaka (zinc) and loha (iron) under the name of *dhâtus*; and two alloys under the name of *sankaras*, *viz.*, kâmsya *i.e.*, bronze or bell-metal (which is made of vanga and tâmra) and pittala or brass (which is made of tâmra and ranga).

The names, number, and classes of metals as given in *Sukranîti* are not, however, the same as in other works on the subject in Sanskrit literature. The

[1] Sukra IV, ii, 171-176. The reader is requested to note the following changes in my translation of Sukranîti: He may read bell-metal for bronze on page 144, and should understand zinc wherever there is tin and tin wherever there is zinc. The word *vanga* is generally a term for tin. But in *Dhâtukriya* of the 16th century *ranga* is also used to denote tin. See śloka 12 in Dr. Ray's edition of Sanskrit Text. That is perhaps the only use. So I take *ranga* as the term for zinc (and not tin, as in the Translation). See Prof. Yoges Chandra's *Ratnaparikṣâ*.

chemico-medical treatises that treat specially of the minerals are very diverse in the matter of enumeration, classification and synonyms. Each represents in fact to a certain extent the cultural characteristics of the place or epoch in which it was composed.

The word *rangaka*[1] which has been taken here as a synonym for zinc has been used only thrice.[2] Another word has also been used as a synonym for *rângaka or* zinc. This is *jasadâ.*[3] But the terms rangaka and jasada are not to be met with in older literature, nor is even the substance which is denoted by these terms mentioned there as one of the metals.

Vedic Period.

In Vedic literature we meet with six or perhaps seven metals : (1) Gold[4] called by the names of Candra, Jâtarûpa, Suvarṇa, Hârita, and Hiraṇya, (2) Silver called Rajata,[5] (3) Copper called Loha,[6] (4) Tin called trapu[7] (5) Iron[8] called Ayas, krisṇayasa, syâma, (6) Lead called Sisâ.[9] Perhaps bronze is also suggested.

According to Messrs. Macdonell and Keith, the exact metal denoted by the word *ayas* when used by itself, as always in the Rigveda, is uncertain. As favouring the sense of bronze rather than that of iron may be cited the fact that Agni is called *ayo-damstra*, (with the teeth of *ayas*) with reference to the colour of his flames, and that the car-seat of Mitra and Varuna is called ayasthuna (with pillars of ayas) at the setting of the sun. Moreover, in the Vâjasaneyi Samhitâ ayas is enumerated in a list of six metals : gold (hiraṇya), ayas, syâma, lohâ, lead (sisa), tin (trapu). Here syâma (swarthy) and loha (red) must mean iron and copper, respectively ; ayas would therefore seem to mean bronze. In many passages in the Atharvaveda and other books the ayas is divided into two species—the syâma (iron) and lohita (copper or bronze). In the Satapatha-Brâhmaṇa a distinction is drawn between ayas and lohayasa which may either be a distinction between iron and copper or between copper and bronze. In one passage of the Atharvaveda[10] the sense of iron seems certain. Possibly, too, the arrow of the Rigveda which had a tip of ayas was pointed with iron. Copper, however, is conceivable, and bronze quite likely. The Satapatha-Brâhmaṇa states that if " well-melted" it is like gold, referring evidently to bronze.

[1] For the antiquity of the word and its history see *Susruta, Madanapâla* and *Dhâtukriyâ* referred to subsequently.

[2] Sukra IV, ii, 173-175, 176, 183, 144.

[3] Sukra IV, v, 640-648, 658-659.

[4] Max Müllor and Keith's *Vedic Index* Vol. I, 254, 281, 31 ; II, 459, 498, 504, 505.

[5] *Vedic Index* Vol. II, 107.

[6] *Vedic Index* Vol. I, 31 ; II, 234.

[7] *Vedic Index* I, 31, 320.

[8] *Vedic Index* I, 31, 32, 151.

[9] *Vedic Index* I, 31, 452.

[10] V. 28, 1, see Vol. I, p. 272 Harvard Oriental Series.

The following is taken from Dr. Ray's *History of Hindu Chemistry* :[1] 'In Vedic literature iron proper seems to be designated *krisṇâyas* or the black metal,[2] and copper by *lohitâyasa* or the red metal.

Besides gold and silver, several other metals, *e.g.*, iron, lead and tin are mentioned in the white Yajurveda XVIII, 13. In the Chhândogya Upanişad IV, 17, 7, we also read " As one binds gold by means of lavana (borax), and silver by means of gold, and tin by means of silver, and lead by means of tin, and iron by means of lead, and wood by means of iron, and also by means of leather."

At least three metals are mentioned in Atharvaveda,[3] used for amulets to be put on against demons, for long life or for safety. These are gold, lead and iron.

Vedic literature thus testifies to the antiquity of Hindu metallurgy and to the varieties of nomenclature used in designating the metals.

Charaka-Susruta.

The Charaka mentions suvarṇa and five *lohâs* or metals, but does not name any.[4] Kavirâja Avinâs Chandra Kaviratna calls them silver, copper, lead, tin and iron. It is to be noted that the word *dhâtu* does not occur here, and that *lohâ*[5] is a generic name for metals, almost like *ayas* in Vedic literature.

The Susruta[6] mentions six metals under the heading of *trapu* (tin) *order* among the 37 classes of drugs enumerated in Chapter XXXVIII of Sutra-sthâna. These are trapu (tin), sîsâ (lead) tâmra (copper), rajata (silver), krisṇa-loha (iron), and suvarṇa. But in Chapter LXIV, while treating of the *Lavanas*, Susruta mentions 7 metals[7] and describes their properties. The additional one is kâmsya or bell-metal. A new name is also introduced. This is *ranga*, perhaps a synonym or misprint for *vanga*, which is trapu or tin. But if *ranga* be the correct reading, we have here the authority for the use of the term in the same sense of tin in *Madanapâla-nighantu* and *Dhâtukriyâ*, works of the fourteenth and sixteenth century respectively.

The doctrine of six metals continued.

At least five metals are referred to in Mahâbhârata,[8] *viz.*, gold, silver, copper, iron and *Kâmsya*. *Amarakoṣa*, a work not later than the 6th century

[1] Vol. I, first edition, p. 83.

[2] Book I, 16, 35 ; Book V, 28.

[3] The Susruta also differentiates iron by the term *Krisṇaloha* (black metal), though copper is known by its proper name *tâmra*.

[4] See the Sanskrit text edited by the Kavirajas Devendranath Sen and Upendranath Sen (1897), p. 7.

[5] In the section on the *Doctrine of Nine Gems*, the two pairs of convertible terms (1) Dhâtu and loha, and (2) Ratna and maṇi have been treated historically.

[6] See p. 181 of the Bengali translation of *Susruta Samhitâ* by Kavirajas Devendranath Sen and Upendranath Sen (1900).

[7] See the Bengali translation, p. 968.

[8] Prof. Yoges Chandra Ray's *Ratnaparîkṣâ* (1904), p. 154.

A.D., mentions gold, silver, copper, kâmsya, pittala (brass), iron, tin, mercury and *sauviranjana* (*stibnite*). Pittala or brass is thus at least as old as the sixth century. It is also mentioned by Varâhamihira of the same age. The use of mercury as a drug is also at least as old as Varâhamihira.

The *Rasârnava*[1] of Nâgârjuna (8th cent.) mentions six *lohas* or metals: suvarṇa, rajata, tâmra, *tikṣṇa* (iron), vanga (tin) and *bhujangama* (lead). Here we get tîkṣṇa and bhujangama, two new names for substances used since Vedic times.

The *Rasaratnâkara* of the same author gives new names to the metals. Thus silver is *sitâ* and *târa*, copper is *sulvà*, lead is *nâga*.

The *Rasahridaya*,[2] a work of the eleventh century, uses *nâga* for lead, *tikṣṇa* for iron, and gives three classes of metals: (1) noble, *e.g.*, gold, and silver, (2) essential or substantial, *e.g.*, copper, brass (âra), *tikṣṇa* and kânta (varieties of iron), and (3) those which emit fœtid odours, *e.g.*, lead and tin.

The *Rasaprakâsasudhâkara* of the thirteenth century gives the name *târa* for silver. The *Rasakalpa* of the same age mentions six *lohas* or metals, *e.g.*, hema (gold), rupya (silver), arka (copper), vanga (tin), *ahi*[3] (lead) and lauha (iron). Varta and others are also mentioned as alloys.

The 14th century.

The *Rasaratna-samuchchaya* of the fourteenth century, which quotes passages *verbatim* from Rasârṇava and other authorities, begins its Fifth Book that on *lohas* or metals with the following words: 'The *suddha* or pure metals are kanaka (gold), rajata (silver) and loha (iron). The *Puti lohas* (those emitting fœtid odour) are two, *viz.*: nâga (lead) and vanga (tin). The *misra* or alloys are three in number, *viz.* pittala (brass), kâmsya (bell-metal), and varta. The *Loha* metal is loha or iron, and often conveys different meanings.' Here we have five metals divided into two classes, and the 3 alloys regarded as forming a class by themselves. This enumeration, nomenclature and classification of metals may be compared with those in *Sukraniti*, thus :—

(1) *Loha* is the generic name for metal in R. R. S. whereas *dhâtu* is the word for it in Sukra.

(2) Sukra includes *rangaka*, a new metal among the pure metals and thus gives the number seven, whereas according to R. R. S. the number is only five, but six later.

(3) The alloys are two in *Sukraniti*, but three in R. R. S., including *vartaloha* 'which is produced from kâmsya, copper, pittala, iron and lead and is thus an alloy of five matals.'

The *Rasaratna-samuchchaya* often uses *ayas* for iron, and mentions *tikṣṇa* and *kânta* as two of its three species. In Book X, 70, it refers to the six

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[1] See Sanskrit Text edited by Dr. Ray, Vol. II, 89, 90.

[2] See Sanskrit Text edited by Dr. Ray, also *Hindu Chemistry*, Vol. II, p. 11.

[3] See Dr. Ray's edition of the Sanskrit texts in *Hindu Chemistry*, Vol. II.

metals, but mentions only two alloys like *Sukraniti*. *Trapu* is the word used here for vanga or tin.

The *Sârangadhara*[1] of the same age recognises seven metals, though it does not mention zinc, but later names nine metals including two alloys, brass and bell-metal, after the nine planets.

The fourth chapter named *Suvarṇavarga* of *Madanapâla-nighantu*, another work of the 14th century, however, mentions suvarṇa, rupya, tâmra, kâmsya, pittala, ranga or vanga, jasada (zinc), sîsa, lohâ (iron), sulphur, mercury, gems, etc. It gives the synonyms of these metals also, and treats of their properties. It is to be noted that ranga, vanga and trapu are used as synonyms to indicate tin ; and jasada is described as being '*ranga-sadrisa*' *i.e.*, like ranga or vanga.

Madanapâla and Sukra thus agree in almost all particulars. Both mention the same nine metals. Madanapâla does not classify them, and enumerates some more, *e.g.*, sulphur, mercury, abhra, etc., while *Sukraniti* regards the alloys, brass and bell-metal as forming a category distinct from the unalloyed seven. The only real difference is that Sukra takes *rangaka* as something different from *vanga* (which has been always known to be tin). From the composition that he gives of pittala (alloy of copper and *rangaka*) we find no difficulty in identifying his *ranga* with zinc. *Sukraniti* requires to be noted on another point also. This is about the use of the term *jasada*, which has been given in Madanapâla to designate zinc. The *jasada* and *rangaka* of *Sukraniti* are thus synonyms denoting the same substance—zinc.

Though it is not rational to argue anything from mere non-mention we may tentatively conclude, subject to the fallacy of *argumentum ex silentio*, that the portions of *Sukraniti* dealing with metals must be attributed to people living about or after 1374, the year of the composition of Madanapâla-nighantu,[2] but not earlier.[3]

Subsequent notions.

The same seven metals including zinc are mentioned in Dhaturatnamâla, also, another work of the same epoch which gives *Kharpara* the name of *jasada* ; and in the *Dhâtukriyâ* of the 16th century which gives the synonyms of all the metals. In this last work zinc is called jâsatwa, jasa-dâyaka, rupya-bhrâtâ (brother to silver), charmaka, kharpara, rasaka ; [4] and the two alloys mentioned in *Sukraniti* are also enumerated. The tradition of the seven

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[1] See *Hindu Chemistry*, Vol. II, LXX.

[2] See Text edited by Pandit Jivânanda Vidyâsagara (1875), pp. 50-52.

[3] It would be interesting to observe that in Europe also the Doctrine of seven metals held its sway for long. It was supposed that there was a mystic connexion between the planets and the metals. Thus gold, the prince of metals, was the favourite of Sun, the lord of the firmament, liquid mercury was the favourite of the planet Mercury, the changeful deity ; and so on. This idea of the connexion between planets and things of this world will be treated of in the section on the *Doctrine of Nine Gems*.

[4] 'Rasaka and Kharpara are the names generally applied to the mineral calamine.' Dr Ray.

metals is continued in the Bhâvaprakâsa of the 16th century which describes tin by the name of *ranga* and zinc by jasada. But *Râjanighantu* of the 17th century does not mention zinc, though it enumerates the two alloys and seven metals. *Kṣudrasuvarṇa* is mentioned in the place of zinc.

Whether the authors have reckoned only six *lohas* or seven (as since 14th century downwards), the principle has been to count the pure or unalloyed metals only. Later, the doctrine of seven pure metals is replaced by that of eight and nine metals, without reference to their character as pure or alloys. Thus Dr. Râmadâsa Sen quotes a *Vaidyaka* text which regards gold, silver, copper, iron, *Kusya* (zinc), mercury, ranga (tin) and lead as the eight principal *dhâtus*. Another version of the tradition of eight metals is supplied by *Dânasagara* which gives gold, silver, *kâmsya* (the alloy bell-metal), copper, lead, ranga (tin), iron and raita (brass).

The *Sukhabodha* considers nine metals to be chief, *e.g.,* gold, silver, âra (brass), nâga (lead), copper, ranga (tin), tikṣṇa (species of iron, steel), kâmsya (bell-metal) and kânta lauha (species of iron). This list does not give zinc, mentions iron twice, and includes the two alloys which are known to the author as such, according to Dr. Sen.[1]

It is to be noted, moreover, that in the extracts from Bhâvaprakâsa and other works just quoted, the word *ranga* is used not for zinc (as, in *Sukranîti*, a synonym for jasada), but for vanga, trapu or tin (as in Susruta, Madanapâla, and Dhâtukriyâ).

Another fact should draw our attention. In the whole literature on the subject from the earliest times, mercury has not been mentioned in any list of metals, except in the above quotation from vaidyaka ; though its use as a medicinal drug has been known since at least the epoch of *Sârangadhara-Sangraha* (14th century),[2] according to Dr. Dutt, but according to Dr. Ray, since at least the age of Varâhamihira[3] (6th century), who mentions 'iron and mercury among the aphrodisiacs and tonics' in *Brihat Samhitâ.*

Explanation of the number Seven.

The foregoing account will have shown that the '*Doctrine of Seven Metals*' represents only certain stages in the story of metals in Indian literature. Allowing for the fallacy of *argumentum ex silentio,* we have placed it in the epoch between the 14th and 17th century. For an explanation or 'philosophy' of this doctrine we may hazard a hypothesis. Perhaps it is to be sought

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[1] See Râmadasa Sen's *Ratna-rahasya*, a Bengali work already referred to.

[2] 'The oldest work containing a detailed account of the calcination or preparation of the different metals (such as gold, silver, iron, mercury, copper, tin and lead) is, I believe, a concise treatise on medicinal preparations by Sârangadhara.'—Dr. Dutt's Preface to his *Materia Medica of the Hindus*. Dr. Dutt believes that mercury was just coming into use in Chakrapâṇi's time (11th century).

[3] *Hindu Chemistry*, Vol. I, xlvii. First Edition. 'The *Rasârṇava* of Nagarjuna (8th century) is, as the name implies, the 'sea of mercury' and extols the virtues of mercury and its various preparations.' The discovery of this work by Dr. Ray also falsifies the notion of Dr. Dutt and testifies to the antiquity of the internal use of mercury.

in the Theory of Mystic Numbers like three, seven, nine, etc., which has had its day in both eastern and western thought. So far as seven is concerned, in India we have the seven Rishis, the seven mouths or tongues of Fire, the seven *Kulaparavatas* or mountains, the seven rivers, the seven planets or *grahas*, the seven heavens, the seven seas (salt, curd, milk, etc.), the constellation of seven stars called saptarṣimandala, the seven immortals (*chirajīvinah*) etc. The tradition of seven being the number of principal metals may have had its origin in the same tendency of people to tabulate important facts and things of the world according to one or other of the numeral orders. Or, originally, the doctrine may have had nothing to do with mystic numbers—it may have been the result of a simple observation of mineralogical facts.

The arguments of Dr. Ray to prove the indigenous origin of Indian alchemy incidentally throw important light on the doctrine of seven metals both in the east and the west, and demonstrate the absence of any mystic connexion between planets and metals in Hindu thought. 'One of the most favourite doctrines of the neo-Platonists was that the metals were engendered in the womb of the earth under the influence of the planets. According to Olympiodorus (5th century A.D.) lead is begotten by Saturn, electrum by Jupiter, iron by Mars, copper by Venus, tin by Hermes, gold by the Sun and silver by the Moon. * * * Varâhamihira's *Brihat Samhitâ*, if anything, is a repertory of astrological notions. In vain do we look even there for any chance and solitary reference. The alchemical literature of India is equally silent about it. * * * The old Greek writers repeatedly refer to the mystic relationship between the seven planets and the seven metals. * * * The Arabs who adopted many of the Greek doctrines of alchemy also represented the seven metals by the seven planets. * * But in Sanskrit literature we find invariably six metals. It is only in the Sârangadhara and other later works that we find seven metals; * * but this author adds two more to the list and quietly lays down that there are nine metals, which derive their names from the nine planets.[1] * * Râjputana had been overrun and occupied for a brief period by the Musalman conquerors shortly before the time of Sârangadhara, and it is reasonable to suppose that he had gleaned some astrological notions from that quarter.'[2]

Finally, it may be observed that while in India the doctrine of nine gems was influenced by that of nine planets, the doctrine of seven metals was influenced, if at all, by that of *seven* planets.

SECTION 8.

The Economic Mineralogy of Sukrâchâryya's *India.*

(*a*) *The Pure Metals.*

References to gold as to other minerals in *Sukraniti* are commercial, financial and industrial. The statesmen of the Sukra cycle are concerned

[1] See the discussion in the section on the *Doctrine of Nine Gems.*

[2] Dr. Ray's *Hindu Chemistry* Vol. II, lxxxvi—xc.

with them principally as marketable commodities and possessing some 'value.' Identification of these metals, examination of their genuineness, and determination of their 'price' in terms of money are the chief topics dealt with by Sukrâchâryya. A study of these references will thus be a main source of our knowledge of the commercial geography and economic history of India in ancient times, and incidentally of mining,[1] minting, metallurgy and other industries.

It is not safe, however, to infer anything as to the *locale* of *Sukraniti* from the references to mines and metals, as (i) they are more or less of a vague character and (ii) the mineral products are very mobile and easily transportable, commanding what is known as the 'world-market.' Perhaps the definite references to the rates of royalty, remuneration and prices apply to the ideas generally prevalent rather than to those of any one mineralogical zone, *e.g.*, Râjputana, Deccan, &c.

i. *Gold.*[2]

The lustre and brilliancy of gold are well-known to the Sukra authors. Gold,[3] according to them, is the best metal. Its appreciation as an ornament used in decorating the person of human beings is referred to. The making of ornaments with gold is a *kalâ.*[4]

Testing.

There are two methods by which gold can be identified. The first method consists in differentiating it from other metals.[5] The test is given in the rule that "gold of the same weight as other metals is small in volume. Others are bulky." The density of gold being high, there will necessarily be great weight in small bulk. Thus, though the gold coin *mohur* and silver rupee have the same weight, the mohur is smaller in size than the rupee. The second method consists in differentiating pure gold from imitation gold or an alloy or some other metal. The test as described previously is conducted in the following way: "If two pieces of a metal,[6] one pure and the other suspected as alloy, be successively passed through the same hole, and threads of equal lengths be drawn out of them and weighed, and if the weights of both are equal, then the metal is unalloyed, otherwise not." Thus, as Prof. Yoges Chandra Ray says, if the weight of, say, copper wire be 8, that of gold wire of the same length (drawn through the same hole and hence having the same width) would be 19. Or take copper and gold of the same weight, and

[1] For an account of mines and minerals in Modern India, see the Indian Empire in the *Imperial Gazetteer of India* Series. Descriptive and Economic Volumes (I and III).

[2] Principal Burns in his monograph on *Gold and Silver work in the Bombay Presidency* (1904) has dealt with the subject a bit historically. Cf. also "Paris Universal Exhibition, 1878: Handbook to the Indian Court," by Sir George Birdwood, pp. 59-61, second edition.

[3] Sukra IV, ii, 173-175.

[4] Sukra IV, iii, 179.

[5] Sukra IV, ii, 177.

[6] Sukra IV, ii, 178-179.

draw two wires through the same hole; then if the length of gold wire be 8, that of the copper wire would be 19. Both these tests of Sukrâchâryya are thus dependent on the theory of Specific Gravity.

The use of gold in art for decorative or utilitarian purposes necessarily introduces difficulties in the matter of testing the genuineness or otherwise of the material worked upon. The following are the rules for the guidance of people : (1) when one hundred *palas* of gold[1] is taken and melted, it is pure if it still remains one hundred palas, and does not become less. (2) In articles of the best workmanship gold[2] is lost by a two-hundredth part of itself, (while silver by a hundredth part) ; and if soldered by using good material, the weight is increased by a sixteenth part. Having examined the soldering and the workmanship, the increase or decrease should be determined.

The Sukra statesmen are of course specially interested in the ability to distinguish the values of gems and metals and differentiate the genuine from counterfeit coins or imitation from pure metals. And the testing of the worth of gold was certainly a very common phenomenon in Sukra's times, as it still is. For the examination of the genuineness of precious metals supplied an analogy with the examination of the character of officers and servants. Thus we read : "Just as gold[3] is tested by experts by having reference to the lightness or heaviness of weight, colour, sound, etc., so also one should examine servants or officers by reference to their work, companionship, merits, habits, family relations, &c."

As Wealth and as Money.

Several references in *Sukraniti* point to gold and silver, specially the former being the 'measure' or 'standard' of value. Its functions as the 'medium of exchange' is also frequently indicated. Thus among the things to be studied by the king for four *muhurtas*[4] before meals we find gold[5] mentioned along with grains, clothes, jewels, &c. Gold is here to be taken either as a valuable commodity (Bullion) *i.e.*, a form of 'wealth' hoarded in the treasury like grains in the granary, or as coins that have come into the treasury in the process of circulation as 'money' *i.e.*, medium of exchange.

The same may be said of the reference to gold in the rule that advises the king to appoint separate officers to look after elephants, horses, chariots, infantry, cattle, gold,[6] jewels, silver, clothes, &c. It is not difficult to appreciate the importance of having separate officers for gold, jewels and silver. But perhaps there is to be only one officer for all these valuables, whether as bullion or as money, as distinguished from other officers appointed for horses, chariots, &c.

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1 Sukra IV, v, 645. One pala is 8 tolas. One silver pala is therefore Rs. 8.

2 Sukra IV, v, 649-652.

3 Sukra II, 100-109.

4 1 Muhurta=48 minutes.

5 Sukra I, 561-562.

6 Sukra II, 237-238.

That there is to be one officer for these precious metals and stones is clearly indicated in the following lines which describe the qualification of the people in charge of the department: "That man is to be in charge of jewels, gold, silver, and coins who can distinguish their values by their weight, shape, lustre, colour and resemblances." The *mudrâs*[1] or coins may be taken separately as an independent item or as a compound with *svarṇa* and *rajata*, in which case the idea of gold and silver money or currency is unmistakably suggested.

The use of gold in both the functions of money as the standard of value as well as the medium of exchange is also referred to in the following lines :

(1) Houses[2] are meant for gold, jewels, silver, *niṣkas*[3] or coins etc., and other purposes on which expenditure is technically called *bhogya.*

(2) "*Dravya*[4] (lit. goods) is silver, gold, and copper coined for commercial purposes." The term 'Dravya' may be taken to be the equivalent of what is technically called 'Money.'

(3) "Silver, gold and other booty[5] belong to him who wins them. The ruler should satisfy the troops by giving them those things with pleasure, according to the labour undergone.

Uses of Gold.

Besides the mention of gold as ornaments, valuables and coins, we meet with its use for various other purposes. Thus among the ten requisites in the administration of justice[6] there is the mention of gold which is intended to be the material by which the witnesses are to swear oaths. There is here a religious significance pertaining to the noblest of all metals. Gold is also one of the metals used in the preparation of badges,[7] sceptres, &c. The king should mark those who have been his employees by the proper insignia of office placed on steel, copper, bell-metal or bronze, silver, gold and jewels. Again, two men bearing gold sceptres[8] are to be on one side to communicate the presence and salutation of persons to the king.

Then there is the reference to its use in sculpture. Thus just as there are special stones[9] appropriate to each Yuga to be used as materials for the images of gods, so we have the rule that Images are to be of gold, silver, copper, and bell-metal or bronze in the satya, tretâ, dwâpara, and kali ages

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1 Sukra II, 303-304.

2 Sukra II, 692-3.

3 Sukra IV, ii, 205. Niṣka has a technical meaning. It is the value of gold weighing 4 *mâṣâs*, or 32 *ratis*.

4 Sukra II, 712-73. Cf. Jayaswal in the *Modern Review* for November, 1913.

5 Sukra IV, vii, 749-750.

6 Sukra IV, v, 72-73, 79.

7 Sukra II, 853-855.

8 Sukra I, 722.

9 Sukra IV, iv, 310-311, 314.

respectively. The order of metals as given here is certainly according to its depreciation in value and people's estimation.

The State in relation to Gold.

Certain socio-economic and socio-political laws or regulations with regard to gold are to be noticed. First, without the permission of the king the following things are not to be done by subjects, *e.g.* gambling, use of arms, sales and purchases of gold,[1] silver, jewels, poisons &c. Trade in precious metals and stones cannot thus be carried on without a license. Here is another instance of Sukrâchâryya's advocacy of State Intervention in Industry. Secondly, as we noticed before, those who prepare ornaments of gold,[2] jewels, &c., are mentioned among the artists and artisans who should be maintained by the state. Thirdly, the rate of royalty upon gold[3] mining is declared to be one-half of the produce after the expenses have been met.

Fourthly, those who use others' dress, ornaments and gold are guilty of offences called *chhalas*[4] against the moral sense or social etiquette of the community.

Fifthly, those who deal in gold,[5] grains, and liquids collectively will have earnings according to the amount of their share greater, equal or less. Here is a reference to the joint-stock system or collective organisation in connexion with commercial enterprises, and the rule applies to the dividend of share-holders. The same rule applies not only to commerce and trade as given here, but also to joint-stock industries and handicrafts. Thus "the goldsmiths should get remuneration according to the labour undergone by each in cases where they combine[6] to perform a work of art."

Lastly, we have an idea of the rate of remuneration at which the artists are to be paid who work in gold, *e.g.*, for the manufacture of ornaments, seals, emblems, badges, images, sceptres[7] coins, &c. Thus we are told that the goldsmith's[8] wages is to be one-thirtieth the value worked upon if workmanship be excellent, one-sixtieth if mediocre, and half of that if of inferior order. Wages is to be half of that in the case of *kataka* (bracelet), and in the case of mere melting, half of that. And we have noticed previously the tests by which people are to be protected from metal-workers' fraud.[9] There is at least one reference to the character of goldsmiths. Thus it is said that "goldsmiths[10] are the fathers of thieves." Of course, *all* metal-workers are meant.

Exchange-Value.

Last but not least in importance are the references in *Sukraniti* to the comparative values and "prices" of the metals, *i.e*, their values in terms of

[1] Sukra I, 603-608.
[2] Sukra II, 397-398.
[3] Sukra IV, ii, 233-235.
[4] Sukra IV, v, 151-152.
[5] Sukra IV, v, 614-615.
[6] Sukra IV, v, 603-604.
[7] Sukra I, 722.
[8] Sukra IV, v, 653-655.
[9] See the reference to the amounts of material that are lost or increased in workmanship. IV, v, 645-652.
[10] Sukra IV, iv, 88.

"money," and their "exchange-value" not only with regard to themselves, but also with regard to other commodities. The distinction between wealth (*Dhana*) and money (*Dravya*) is certainly known to the statesmen of the Sukra cycle. We have noticed above the recognition of the distinction between bullion and coin in *Sukraniti*. The 'unit' of currency and monetary measurement as well as prices and other allied subjects will be discussed in the chapters on the *Data of Ancient Indian Economics* and *Public Finance*.

It may be noticed here that both gold and silver seem to be mediums of exchange and "legal tender" in *Sukraniti*. Prices are mentioned sometimes in terms of gold, often in terms of silver. "Eight *ratis* make one *mâṣâ*, ten *mâṣâs* make one *suvarṇa*.[1] Five times that *suvarṇa* make eighty silver *karṣakas*." The Suvarṇa and Karṣaka are gold and silver *coins* respectively, and one Suvarṇa is equivalent to sixteen Karṣakas. The same ratio[2] is also noted by Sukra in determining the comparative value of gold and silver as bullion or ingot. Thus "the value of gold[3] is sixteen times that of silver."

The face-value and metallic value of the gold coin were the same in the mediæval Chola Empire (800—1200 A.D.) The statement in *Sukraniti* can be well illustrated by the following extract from Aiyangar's *Ancient India*: "The unit of currency was the gold *Kâsu* (28 grains Troy). This coin appears to have passed for its metallic value, because the great Râjarâja got all gifts to the temple carefully weighed and appraised. All gold ornaments among these are entered with their weights alone, but no value is given, while jewels set with briiliants, etc., are entered with their weights and their value in *Kâsu*. We can safely infer that the *Kâsu* passed for its weight in gold, although its value in grain and cattle might vary."

In 1883, *i.e.*, about thirty years ago, Dr. Râmâdâsa Sen noticed the ratio of gold to silver to be 1 to 20. To-day it is about 1 to 24. There has thus been a great decline in the value of silver *as money*, *i.e.*, a falling off in the purchasing power of silver coins since the days of Sukrâchâryya. It would be an interesting study in Indian Economic and Financial History to find out the epoch or epochs when the ratio given by Sukrâchâryya held good. That would go a great way in fixing the age of the portions of *Sukraniti* referring to the currency.[4]

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[1] Sukra IV, ii, 138-139.

[2] It would thus be evident that both nominal or "face" value and intrinsic or "real" value of the coins are the same. There is no law artificially regulating the price of the coins and the precious metals. The market value of the metals (as indicated by the relation between gold and silver as bullion) was maintained in the currency.

[3] Sukra IV, ii, 181.

[4] This will be dealt with in a subsequent chapter. Statistics given in Brihat Samhitâ (6th cent.), Yuktikalpataru (11th cent.), and Ayeen Akbari (16th cent.), would supply valuable materials for a history of Indian Prices. The Bengali work of the 17th century, the *Kavi-Kankaṇa-Chandi*, and *Seir Mutaqherin* of the 18th century are also important documents of socio-economic history.

According to Dhâtukriyâ, a Tantric work of the 16th century, Mahâdeva enumerates to Pârvati the following places as sources of gold and auriferous ores: *Pâvakadri* (?), seaside countries, Sindhu, Kâmarûpa, &c.

ii. *Silver.*

Like the sun and the moon, gold and silver have been mentioned in *Sukraniti* almost as twins. References to the two metals have been made together both explicitly as well as implicitly. Thus our information about silver is nearly the same as about gold, whether as regards (1) examination as to genuineness, or identification, (2) the uses as money *i.e.* standard of value and medium of exchange, (3) the socio-economic and socio-political regulations, (4) the uses in decorative or useful arts, (5) the rates of royalty upon mining and (6) wages to artists, or as regards (7) the circulation as 'legal tender.' The Sukra statesmen have supplied us with parallel facts on all these points in connexion with the two noblest of metals. The following account deals with the remarks about silver.

The examination[1] of silver need not detain us for it is the same as that of gold and other metals.

The wastage or increment of silver inevitable in the industrial processes are known by the following rules: (1) "Silver is diminished by four-hundredth part[2] when melted; if it is otherwise, the artisan should always be punished by the king. (2) In articles of best workmanship silver is lost by a hundredth part; and if soldered by a good material the weight is increased by a sixteenth part.

Silver[3] is mentioned along with gold (1) as a valuable commodity or as coins to be studied by the king for four *muhurtas* before meals, (2) in connexion with the appointment of officers[4] in charge of jewels and coins, (3) in connexion with expenditure on houses that are meant for valuables,'[5] (4) in the definition of *dravya*[6] or 'Money,' and (5) as booty[7] to be distributed among the soldiers by the king.

Besides the uses of silver as ornaments, valuables and coins, we find references in *Sukraniti* to the metal being used (1) in the preparation of badges[8] by which officers are to be distinguished, and (2) in the construction of images in *Tretâyuga.*[9]

The socio-economic laws regarding silver are also the same as those for gold. Thus (1) trade in silver[10] cannot be carried on without a license. (2) The rate of royalty upon silver[11] mining is declared to be one-half of the produce after the expenses of extraction have been met. (3) The references to (*a*) *chhalas* and (*b*) joint-stock organisation are implied,[12] though silver has not been

1 Sukra IV, ii, 178-179.
2 Sukra IV, v, 646-47, 649-652.
3 Sukra I, 561-562.
4 Sukra II, 303-304, 237-238.
5 Sukra II, 692-693.
6 Sukra II, 712-713.
7 Sukra IV, vii, 749-750.
8 Sukra II, 853-55.
9 Sukra IV, iv, 314.
10 Sukra I, 603-608.
11 Sukra IV, ii, 233-235.
12 Sukra IV, v, 151-152, 614-615.

definitely mentioned. (4) The rate of remuneration for the artist is given below : The silversmith's wages[1] is to be half of the material worked upon, if workmanship be of the highest order, half of this if mediocre, half of that if inferior, and half of that in the case of *kataka* (bracelet). In the case of the craft conducted on joint stock principles, the silversmiths are to be governed by the same rule as goldsmiths.[2]

The silver coin is called *karṣaka*,[3] sixteen *karṣakas* make one *suvarṇa* or gold coin. The ratio of silver to gold *as money* is exactly the same as that *as bullion*. Thus "the value of gold is sixteen times that of silver.[4]" The comparative value of silver and copper is also given. "The value of silver is almost eighty times that of copper." The financial and economic questions[5] connected with the metals will be dealt with in a separate chapter.

It now remains to note one remark about silver which the Sukra authors have not made regarding gold or other metals. "The king should daily receive from the sales of silver[6] one-fifth, one-fourth, one-third or one-half—not more" It is difficult to see the propriety of this, since the royalty on mining has been once described and since the duty on sales has not been mentioned as regards other metals.

The following extract relates to the antiquity and history of silver-extraction in India :—

"Solomon is said to have hired fleets of ships from Tarshish for the purpose of obtaining from Ophir the silver used in decorating his palace and temple. The latter place has been identified by some writers as a port or district on the Malabar coast; but at least it is undoubted that Pliny, who wrote A.D. 77, referred to India as a country whence silver was obtained for the use of the Romans.[7] * * * There seems good reason to believe that the Chinese obtained silver from Malabar. * * * In the *Ayeen Akbari*, written about the end of the sixteenth century, silver mines are mentioned near Agra and in Kashmir. * * * Tavernier in his *Travels* says in one passage that Japan is the only Asiatic country where silver occurs, but afterwards cites Bhutan and Assam as possessing silver mines."

iii. Copper.

The examination of copper has to be conducted according to the same method as that of gold and silver. The wastage[8] of copper in industries amounts to one-hundredth part.

[1] Sukra IV, v, 656-657.

[2] Sukra IV, v, 603-604.

[3] Sukra IV, ii, 190.

[4] Sukra IV, ii, 181, 182.

[5] For Indian Numismatics, see the *Historical Volume*, and for Modern Indian Currency and Prices, see the *Economic Volume* of the *Indian Empire* in the *Imperial Gazetteer Series*.

[6] Sukra IV, v, 643-644.

[7] *Dictionary of the Economic Products of India*, Vol. VI, Part III, pp. 238-243.

[8] Sukra IV, v, 647.

Copper is not mentioned as a valuable to be hoarded nor as a material for ornaments. Badges,[1] however, are made of this material. Images[2] of gods also are constructed out of copper in *Dwâparayuga*.[3] The rate of royalty upon copper mining[4] is one-fourth of the produce. The coppersmith[5] is to get one-fourth of the value worked upon as wages.

Copper coins are mentioned in the definition of Dravya or 'Money' along with gold and silver (II, 712-713). A *paṇa*[6] is a piece of copper coined by the king weighing ten *mâṣâs*. The following comparative values[7] define the position of copper in the scale of prices: "The value of silver is eighty times that of copper. The value of tin is one and a half times that of copper, that of zinc twice that of tin, *i.e.*, thrice that of copper, that of lead thrice that of tin, *i.e.* four times and a half of that of copper, that of iron six times." Excluding cowries, copper coin is thus of the lowest value in the realm, gold being the highest and silver intermediate. The currency questions will be discussed in a subsequent chapter along with the historical significance of the prices.

It remains now to note that among artisans to be 'protected' by the king we find the mention of coppersmith;[8] and that copper is a constituent[9] of two alloys: (1) bell-metal or bronze, together with tin, and (2) brass, together with zinc.

In the *Dhâtukriyâ* of the sixteenth century, the following places have been enumerated as the sources of copper: Nepal, Kâmarûpa, Bangala, *Madaneswar*(?), *Gangâdwâra*(?), *Malâdri*(?), the country of the Mlechchhas, *Pâvakâdri*(?), Rûma (Constantinople), the country of the Phirangas (Portuguese and Europeans).

Mr. Medlicott, F. R. S., gives the following distribution of copper in the *Dictionary of Economic Products of India*: Singhbhum, Dhalbhum, Hazaribagh, Rajputana States, Ajmir, Afghanistan, Kumaon, Gharwal, Darjiling, Western Duars, Kurnul and Nellore.

"In ancient times copper mines were worked on a larger scale than at present."

The importance of copper in Hindu religious ceremonies is thus described in the *Journal of Indian Art*:[10] "Fine shrines for the god, with excellent flower-carvings; dishes or platters with tanks or lotus patterns nicely worked out; the pedestal for the placing of the image during the sacred bath; the vessels except when the worshipper is rich and can afford silver ones, and everything connected with the performance of Hindu worship are made of copper."

[1] Sukra II, 853-855.

[2] For copper in Indian Art, see Vincent Smith's *History of Fine Art in India and Ceylon*, pp. 171-172, 198, 304. *Vide* also Birdwood's *Paris Universal Exhibition*, 1878, pp. 01-2 (2nd Edition).

[3] Sukra IV, iv, 314.

[4] Sukra IV, ii, 233-235.

[5] Sukra IV, v, 658-659.

[6] Sukra IV, i, 233.

[7] Sukra IV, ii, 182-184.

[8] Sukra II, 309.

[9] Sukra IV, ii, 176.

[10] P. 20, Vol III, No. 29.

iv. Iron.

Iron is an important substance, though it is not used as material for coins. The list of 64 *kalâs*[1] or practical arts, as well as the enumeration of the artisans[2] and artists to be maintained by the state, indicate the place that iron occupies in Industrial life. We may note that iron-images[3] are also recommended.

The wastage[4] of material involved in workmanship amounts to one-eighth part. The wages[5] of the blacksmith may be half of, or equal to, or twice or eight times of, the value worked upon. The rate of royalty[6] is one-sixth of iron upon the produce after the expenses have been met.

Among the industries[7] in which iron plays a conspicuous part are those connected with warfare. The arms and weapons, chariots and ordnances all require the use of iron. The Sukra authors have noticed it. Needles and razors have also been mentioned. We are also told that even the hard iron can, by proper methods, be converted into a liquid.[8]

The value of iron[9] is six times that of copper.

In his *Handbook to the Indian Court*[10] at the Paris Universal Exhibition of 1878, Sir George Birdwood remarks : "Iron is frequently mentioned in the Bible under the Hebrew name of *paldah*, which is the Arabic *fulad*, and indicates Indian iron." And Mr. E. B. Havell[11] is of opinion that in the use of steel "Hindu craftsmen had no rival until quite modern times," and refers to the notes on the use of wrought-iron girders in Orissan temples in *Orissa and her Remains* by Mr. Manomohan Ganguly, B. E.

The following gives the geographical distribution of iron ores according to Dhâtukriyâ (16th century): Lohâdri, Gayâdri, Gautamâdri, Vindhya, Nalâdri, Tryamvaka, seaside places.

v. Tin.

Information about this metal is very small in *Sukraniti*. We are told that the wastage of the material in industrial processes amounts to one-sixteenth part.[12] The rate of royalty upon tin-mining[13] is one-sixth of the produce after the expenses have been met. The workman's remuneration[14] is one-fourth of the value worked upon. We are not told what are the industries in which tin plays a part, except that together with copper it makes the

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[1] Sukra IV, iii, 192-200.

[2] Sukra II, 393-411.

[3] Sukra IV, iv, 317.

[4] Sukra IV, v, 646-648.

[5] Sukra IV, v, 658-650.

[6] Sukra IV, ii, 233-35.

[7] See references to chariots (IV, vii, 60-63), nâlikâstras (IV, vii, 380-394), cannon-balls and bullets (IV, vii, 407-408), gunpowders (IV, vii, 411-15), and the weapons (IV, vii, 422-34).

[8] Sukra IV, vii, 588-90.

[9] Sukra IV, ii, 183-184.

[10] Second Edition p. 28.

[11] Indian Architecture, p. 122.

[12] Sukra IV, v, 646-648.

[13] Sukra IV, ii, 233-235.

[14] Sukra IV, v, 658-659.

alloy bell-metal[1] or bronze. The proportion of the constituents is not stated. The value of tin[2] is one and a half times that of copper.

India is not naturally rich in tin-ores, the deposits "being more of mineralogical than practiceal interest ; as modern geological surveys indicate. In certain parts of the Malaya Peninsula and Burma, however, rich deposits of tin-stone occur." Oldham and Ball have described these occurrences in Further India.

Says Dr. Watt[3] "tin has been known in India from a very remote period, and early held an important place in Sanskrit Materia Medica, being mentioned by Susruta. The supply was probably obtained from Burma or from some of the tin-producing islands of the Malaya Archipelago ; between which and India trade must have existed in very ancient times."

But, as we have seen, tin was familiar to the Hindus even in Vedic times. The connexion (commercial, and also political) between India and Further India must therefore be inferred to have existed so early as that. And according to Birdwood,[4] "Homer mentions tin by its Sanskrit name *Kastira* ; and the Phœnicians, who first learnt the name from the trade through the Arabs with India, afterwards gave the name of Cassiterides to the Scilly islands and Cornwall where it still survives in Cassiter street, Bodmin."

vi. Lead.

Information about lead in *Sukraniti* is as meagre as that about tin, though it is slightly greater. Thus we are told that lead-images[5] may be constructed for religious purposes ; and that lead may be used for cannon-balls[6] and also as an ingredient of gunpower.[7]

The wastage[8] of material in industrial processes amounts to one-sixteenth part, the artisan's remuneration is not mentioned. The rate of royalty upon lead-mining is one-sixth of the produce after the expenses of extraction have been met. The value of lead is thrice that of tin *i.e.*, four times and a half of that of copper.

The geographical distribution of lead is thus given in Dhâtukriyâ of the 16th cent. : Nepâla, Kedâra, Karmakânda, Tryamvaka, Tripura.

" Although at the present time lead ores are not largely worked in India, Ball[9] states that there is probably no metal of which the ores have been worked

[1] Sukra IV, ii, 176.

[2] Sukra IV ii, 183.

[3] See *Dictionary of the Economic Products of India*, Vol. VI, Part IV, pp. 57-62. On the authority of Dr. U. C. Dutt, Dr. Watt traces the antiquity of tin to Susruta. But for recent researches, see Macdonell and Keith's *Vedic Index*, I, 31, 326.

[4] *Paris Universl Exhibition* (2nd Edition), p. 28. Mr. Schoff, however, believes *Kastira* to be a non-Sanskrit word, cf. *Periplus*, p. 70.

[5] Sukra IV, iv, 317.

[6] Sukra IV, vii, 407-408.

[7] Sukra IV, vii, 411-415.

[8] Sukra IV, v, 646-48.

[9] *Dictionary of Economic Products of India* (1890), Vol. IV, pp. 602-3.

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to so large an extent in ancient times, excepting those of iron. This is testified to by the number of old mines in Southern India, Râjputana, Baluchistan, and Afghanistan."

According to Mr. Schoff's *Periplus*,[1] "Lead and Tin are mentioned in the *Artha Śâstra* as alloys used in coining."

vii. Zinc.

We have already noticed several important points in connexion with the use of zinc in India under the heading of the *Doctrine of Seven Metals.*

The wastage[2] of material in industrial processes amounts to one-sixteenth part. The remuneration[3] of the workman is one-fourth of the value worked upon. The rate of royalty upon mining is not given. Its value is twice that of tin, *i.e.*, thrice that of copper.[4] It enters into the composition of the alloy brass,[5] together with copper; but the proportion of the constituents is not given.

Dhâtukriyâ, a Tantric work of the 16th century, enumerates the following sources of zinc : *Kumbhâdri*, Kâmboja, Rûma, Balkh, Bangala.

"Zinc, according to Mr. Dampier,[6] "appears to have been introduced into Europe from India, whence, as in the similar case of muslin and calico, it has returned in such volume as to oust the original native product.

"Zinc[7] occurs in nature, in combination with sulphur, forming the sulphide or zinc *blende,* with oxygen forming *zincite*; and more rarely as a silicate, carbonate, sulphate or arsenate. * * * "The only considerable deposit of zinc ores, which has been extensively worked in the peninsula, occurs in this region (Râjputana) at Jawar in the Udepur State. ° ° ° In Colonel Tod's *Râjasthan*, the mines are alluded to incidentally as having yielded an annual revenue of Rs. 2,22,000. ° ° ° The mines were closed during the famine of 1812-1813 and have not since been re-opened. The ore appears to consist chiefly of zinc carbonate."

Mr. John Henry Pepper in *The Play-Book of Metals* gives the following history of zinc in the west: "The metal was not known to the ancients, although they were acquainted with the mineral cadmium or calamine; and without it they could not have made brass. Hesiod states that 'in remote ages the earth was filled with brass implements of agriculture, because iron had not been discovered.' The use of calamine in the composition of brass was known to Aristotle, who makes a distinction between the compound resulting from the mixture of copper and calamine and that resulting from the mixture of copper

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[1] P. 221 (Longmans, 1912).

[2] Sukra IV, v, 646 648.

[3] Sukra IV, v, 658-650.

[4] Sukra IV, ii, 183-184.

[5] Sukra IV, ii, 176.

[6] *Monograph on Brass and Copper wares* (1894), p. 21.

[7] *Dictionary of the Economic Products of India*, Vol. VI, Part IV (1893), pp. 356-357.

and tin.[1] * * * Zinc appears to have been first called by that name in the writings of the madly-Zealous Paracelsus, about the year 1540."

We have seen previously that zinc has been mentioned by the Hindus as a separate metal by King Madanapâla of Kanauj in 1374.

(b) The alloys.

Two alloys[2] are mentioned in *Sukraniti*: (1) kâmsya which may be either bronze or bell-metal, and (2) pittala or brass.

Kâmsya is the alloy of tin and copper, in what proportions, it is not stated. It is mentioned (1) as one of the materials that may be used in the manufacture of badges[3] by which the officers of the state are to be distinguished from one another; and (2) as the material to be used in the construction of images[4] for the *Kaliyuga*.

We are not supplied with any information as to the duties on commercial transactions, the rate of remuneration of the workmen, &c., as we are not told anything about the other alloy.

"Brass and bronze play in the Hindu household as important parts as glass and china wares among the western nations.[5] * * The Hindus influenced strongly by a * * feeling against using earthen and wooden wares, have been using from time immemorial, brass and bronze wares for domestic purposes, and copper ones on ceremonial occasions."

The treatment of brasses and bronzes in mediæval Hindu art has been described by Mr. Vincent Smith[6] in connexion with South Indian workmanship. He has given illustrations of brass portrait images of Krisṇarâya of Vijayagara (A.D. 1510-29) and his queens, Natarâja or dancing Siva from Tanjore, the Bronze Pârvatî (12th cent), bearded Râmchandra in bronze (18th cent. ?) and plunging horse in bronze cast. Mr. Smith also refers to the many-sided genius of Vitapâla, the East Indian worker in bronze and stone, of Pâla times.

SECTION 9.

General remarks on Gems in Sukraniti.

Pearls have been fished along the Coromandel Coast from long before the time of Alexander's invasion. Pearls, precious stones and gold have been known in India as elements of ornament from time immemorial. Manu ordains a fine for piercing fine gems as diamonds or rubies and for boring

[1] Edition of 1861, pp. 494-95. See also *Encyclopædia Britannica* (11th Edition), Vol. 28, p. 981.

[2] Sukra IV, ii, 176. *Vide* Birdwood's *Paris Universal Exhibition*, 1878, pp. 61-63.

[3] Sukra II, 853-855.

[4] Sukra IV, iv, 314.

[5] The *Decline of South Indian Arts* by Pandita Natesa Sastu in the *Journal of Indian Art*, Vol. III, January 1890.

[6] For bronze as a material in Indian Art, see Vincent Smith's *History of Fine Art in India and Ceylon*, pp. 179-180, 230, 266-7, 305-7.

pearls or inferior gems improperly. Râjendralâl quotes *Mrichchhakati* or "Troy-Cart" of the 1st cent. B. C. to show that the author Sudraka did not think it inconsistent to describe, in the courtyard of a common courtezan's house, jeweller's shops, "where skilful artists[1] were examining pearls, topazes, sapphires, emeralds, rubies, lapis lazuli, coral and other jewels; some set rubies in gold, some work gold ornaments on coloured thread, some string pearls, some grind the lapis lazuli, some pierce shells, and some cut coral." Nor were the people satisfied with such originals; the requriments of society rendered the fabrication of false jewellery a commonly practised art, in fact, one of the 64 *Kalâs* according to Sukrâchâryya.

The authors of Sukra cycle have mentioned jewels and precious stones mainly as valuable articles of commerce. As such, references to these in Sukranîti are parallel to the remarks about gold and silver, the two noble metals. Sometimes of course the word *ratna* or gem is used metaphorically when it includes the noble metals as well. There is at least one remark of Sukra which takes the term metaphorically and gives reasons also. "Those which are rare in this world are priced as gems."

As valuable commodities, the gems are hoarded in the treasury and demand the king's attention of four muhurtas[2] before meals. They require a special officer[3] to look after them with the qualifications of a mineralogist, who can detect the false stones and select the genuine ones. Special houses that are to be built for them are erected at a cost which is technically known as *bhogya.*[4]

The definition of *dravya*[5] or 'Money' includes not only the metallic coins but also gems and cowries. The custom of distributing booty[6] among the soldiery applies to gems also, though they are not distinctly mentioned. Jewels like metals may be used to serve the purposes of badges[7] meant for distinguishing between officer and officer. Trade in jewels[8] is forbidden without a charter or license. Like the goldsmiths, coppersmiths and other metalworkers, artists[9] and artisans in gems and jewels also deserve encouragement and "protection" of the state.

The use of jewels belonging to some other person is one of the *chhalas*[10] or social offences recognised by the state. This is to be guessed from the description of the offence with regard to gold and ornaments. Similarly also, the rule about dividends of joint enterprises[11] and collective dealings in precious stones, is to be inferred from that with regard to gold, grains and liquids.

We have been told that jewellers should be patronised by the state, but information as to the rate of remuneration is not available. The rate of

[1] Wilson's *Hindu Theatre*, II, 85.
[2] Sukra I, 501-502.
[3] Sukra II, 303-304, 237-238.
[4] Sukra II, 602-603.
[5] Sukra II, 712-713.
[6] Sukra IV, vii, 749-750.
[7] Sukra II, 853-855.
[8] Sukra I, 603-608.
[9] Sukra II, 397-398.
[10] Sukra IV, v, 151-152.
[11] Sukra IV, v, 614-615.

royalty, however, is mentioned It is declared to be half of the *net* yield of precious metals, *i.e.*, after the expenses of extraction and production have been met. The realisation of Government revenue from *ratnas*[1] is important enough to be recognised as an item that should be studied by the *Sumantra* or Finance Minister. Besides the revenue accruing regularly from the *âkaras* or mines, Sukrâcharâyya's system of Public Finance recognises *Ajnâtaswâmika*[2] income. It is that wealth whose owners are unknown. Gems and jewels (*Nidhi*) picked up in streets escheat to the state and constitute this class of income.

Among property laws it is mentioned that the father is the lord of all gems[3] etc., but neither the father nor the grand-father has authority over all immovables. This is a regulation about *all* precious movables.

We have thus far noted the parallelism between gems and noble metals as valuable commodities. The fraud that may be committed with regard to them, *e.g.*, by the passing off of imitation jewels as genuine ones has also to be noticed. It is mainly to guard the treasurer, the minister of Public Finance and the king as well as the people that the Sukra statesmen have introduced the topics of Economic Mineralogy in their *Nitisâstra.* If it is the ornament of jewels to have splendour,[4] and if it be a general custom to present jewels and ornaments[5] to females at marriage, it is necessary that people should have the eye to find out what is the proper splendour of a jewel. Besides, there are natural defects[6] in gems. It is known also that people of the island of Ceylon can make artificial[7] pearls, The making of artificial gems[8] is in fact known to be a *kalâ.* Like the testing of gold and other metals, therefore, testing of gems as to whether they are good or bad, as possessing marks or holes, has been recognised as a *kalâ.* The advice to rich people and kings necessarily is: "The wise man should determine their value by carefully examining[9] them." "The king should keep the jewels after having them tested by experts as well as by himself."

The following general rule may help people in testing the worth of precious stones: "Those who are experts in the study of gems describe that gem as the best which has no pores,[10] has good colour, is without scratches and spots, has good angles and bright lustre."

The general information about colour and shape is being made more clear in the following lines: [11] (1) "Gems (*a*) may have the colour of *sarkara* (powdered bricks) or leaves of trees, and (*b*) may be flat or round in shape; (2) "The colour and lustre of gems may be white, red, yellow and black."

There are two technical terms[12] here used in connexion with the splendour of precious stones, *viz.*, *Chhâyâ* and *Prabhâ.* The terms have been defined

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[1] Sukra II, 211-212.
[2] Sukra II, 650-657.
[3] Sukra IV, v, 577-578.
[4] Sukra II, 463-479.
[5] Sukra IV, ii, 171.
[6] Sukra IV, ii, 124.
[7] Sukra IV, iii, 178.
[8] Sukra IV, iv, 21-22.
[9] Sukra IV, ii, 171-172, 79-80.
[10] Sukra IV, ii, 97-98.
[11] Sukra IV, ii, 99-100.
[12] Sukra IV, ii 103.

by Sukra thus : (1) "The *Chhâyâ* is that which attacks,[1] overpowers, and eclipses the colour (of other substances)." (2) The *Prabhâ*[2] is that which reveals the colour (of other substances). Prof. Ray in *Ratnaparikṣâ* explains the remarks of Sukra in the following way: The light of a lamp does two things simultaneously : (1) It removes the darkness and makes other objects visible, *i.e.*, makes it possible for them to display their colour and attributes. (2) It prevents like objects, *e.g.*, white paper or milk, from displaying their proper colour and attributes. The first function of the lamp is due to its lustre or *prabhâ*, the second is due to its *chhâyâ*. The light issuing from a lamp or a jewel may thus be divided into two branches—(1) *reflected*, which makes other things visible, (2) *transmitted* which eclipses other objects.

As for the value of precious stones, Sukra statesmen know that it depends on both Demand and Supply. Omitting from one's consideration the factors that go to make "Demand-Schedule," as it is called by Professor Marshall, we may note the following conditions on the Supply side. These conditions[3] give in fact additional tests by which the splendour, lustre, and beauty of jewels are to be determined, and the considerations which weigh much in people's estimation :—

(1) Other things remaining the same, the "exchange-value" of a gem depends on its weight, lustre, colour, extent, receptacle and shape.

(2) Other things remaining the same, the 'exchange-value' increases if there be great bulk with small weight, and decreases if there be small bulk with great weight.

(3) Other things remaining the same, 'exchange value' is smallest if the lustre be that of *sarkara* (reddish powder of bricks) ; is middling if the shape be flat ; and greatest if the lustre be that of green leaves.

(4) Other things remaining the same, round jewels are not much appreciated and their 'exchange-value' depends on the "Demand-Schedule."

The following information about gems recorded by the authors of the Sukra cycle is useful :

(1) The gem on the head of the snake[4] is the best of all, of great splendour, but very rare. The tradition is old enough. The real explanation of gems lying in the heads of snakes is that these creatures carry bright stones in their mouths when they have to move in the dark. These they pick up from stocks and stones in hills and mines and forests. When they get their prey, they throw these jewels away from their mouths for a time, and carry them again as lamps to point out their way, when they have finished their work at the spot.

[1] This is the explanation of Prof. Yoges Ch. Ray. The reader is requested to note the difference from my translation of the hemistich on p. 141 of the Sacred Books of the Hindus Series XIII.

[2] P. 24, Edition of 1904.

[3] Sukra IV, ii, 107-114.

[4] Sukra IV, ii, 96.

(2) Except pearls and corals the gems cannot be cut or written upon[1] by iron and stones (diamonds). This is said by those who are experts in gems.

(3) The value of gems is measured by weight.[2]

(4) One should receive knowledge, *mantra*, medicine, wife and gems[3] even from low families. This general rule of morality may be compared to Chāṇakya's[4] adage that one should take gold from even the impure (persons or places), the jewel of a wife from even low families, and good (useful) knowledge from even the lowborn. It is implied that medicines, gems, &c., were in Sukra's days, as in ancient Hindu times generally, dealt in by the low class men. Here is the sanction that these things may be accepted from persons, who, otherwise beyond the pale of high society, are, however, experts in their subjects.

(5) The gem that has its appropriate colour and lustre and is devoid of any defects is beneficial to beauty,[5] growth, fame, valour and life. Others are known to be injurious. This notion about the efficacy of precious stones obtains with regard to noble metals also, and has had its sway since time immemorial, both in the Eastern and Western worlds. The story of the Talisman is well-known, and we have already quoted extracts from Vedic literature bearing on this point.

(6) The above general idea has been crystallised by Sukra sociologists into a definite maxim of sound health. Thus we are told (*a*) that one should always use medicinal substances in jewels[6] consecrated by charms or mantras. (*b*) One should never wear gems that have black or red spots.[7]

(7) Gems found in the Gandaka[8] river are natural images, and need not be given to the sculptor to try his skill upon. And we are told that, whereas in the case of images constructed by artists one should thoroughly examine their parts and proportions according to the canons of *Silpaśâstras*, these and other natural stones should not be examined at all.

(8) Gems never lose their natural attributes. These cannot deteriorate. But pearls and corals can. It is only the wickedness of kings[9] that leads to fluctuation in their exchange-values.

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[1] Sukra IV, ii, 100-110.

[2] Sukra IV, ii, 129, *Gomeda* is the exception. It is not to be weighed, being very insignificant. The standard of measurements of precious stones is given in Sukra IV, ii, 130-133.

[3] Sukra III, 193-194.

[4] Amedhyâdapi Kânchanam,
Nīchadapyuttamâ vidyâ Stri-ratnam duskulâdapi.

[5] Sukra IV, ii, 101-103.

[6] Sukra III, 8-9.

[7] Sukra IV, iv, 307-308. Such other natural images are *Vanalingas*, *Chandrakântas*.

[8] Sukra IV, ii, 115-116.

[9] Sukra IV, ii, 150.

SECTION 10.

The Doctrine of Nine Gems.

Nine is a mystic number like seven. In Indian thought we have the tradition of nine planets, nine gems, nine nights (called *navarâtra*,[1] meaning thereby the sacrificial rite that is finished in nine days or nights), nine *rasas* (or feelings and emotions, *e.g.*, amorous, ludicrous, pathetic, vehement, heroic, terrific, loathsome, absurd, and peaceful, according to Hindu canons of literary art), the nine *lakṣaṇas* (or marks of Brahma) according to Vedânta Paribhâṣâ, the nine *Saktis* (or energies), the nine castes (of the Sudra order, according to Parâśara Samhitâ), the nine doors (*e.g.*, two eyes, mouth, etc., of the human organism), the nine islands of the Ganges (which, according to the Vaiṣṇava poet, Narahari Dâsa, formed the site of what in later times has been Navadvîpa or Nadia, the land of Chaitanya), also the nine tests of Kulinism propounded by king Ballâla Sen of Bengal (12th cent.).

The doctrine of nine gems, like that of the seven metals, has an interesting history. Indian tradition has taken the nine gems both literally and metaphorically. In this latter aspect we have it when we refer to the strong popular notion about the "Navaratna"[2] of the court of Vikramâditya. The legends of Vikramâditya cycle, like those connected with Alexander, Arthur and Charlemagne in European literature, refer to things that are half-historical, half-mythical. The hero himself, round whom the romances have grown, has not yet been indentified. Some of the incidents connected with Vikramâdityan tradition have in these days been ascribed to Samudragupta, the Indian Napoleon, in whose conquest of the four quarters of India, scholars have seen the historic counterpart of the Kalidâsic hero Raghu's *Digvijaya*. We know the age of Samudragupta (4th cent. A.D.), or for the matter of that, of the Vikramâditya of legendary fame, to be one of the most glorious epochs of Hindu culture, one of the Augustan ages of Indian literature. There can be no objection, therefore, to regarding this Gupta monarch as the patron of several groups of nine celebrated intellectual giants,

[1] See the word *Navaratna* in the Bengali *Viśvakoṣa* (Encyclopaedia Indica) edited by Mr. Nagendranath Vasu, Vol. IX, pp. 653-657 (First Edition, 1898). This Volume gives several words beginning with *nava* or nine, which are important as testifying to the tradition. The word *Navanavaka* occurs in Dakṣa Samhitâ (III; 3) as a mnemonic for nine groups or classes of householder's duties, each consisting of nine functions. Thus we have nine *amritas* or sweet functions, nine gifts, nine duties, nine forbidden things, nine secret activities, nine successful functions, nine failures, nine public activities, and nine things (not to be given away).

[2] These are Dhanvantari (the physician), Kṣapaṇaka (the philologist), Amarasimha (the lexicographer), Sanku (the elocutionist), Vetâlabhatta (the necromancer), Ghatakarpara (the Politician), Kâlidâsa (the poet), Varâhamihira (the astronomer), and Vararuchi (the grammarian of Prâkrit languages). The couplet containing the names of the nine luminaries of Vikramâditya's court is found in the last chapter of *Jyotirvidâbharaṇa* by the astrologer, named Kâlidâsa (13th century).

who are figuratively known as the *Navaratna.*[1] But Indian chronology cannot as yet bear out the tradition that the great luminaries included in the term *Navaratna* ever shone in the intellectual firmament of India at one and the same time. To take only two instances. If the Gupta monarchs were the patrons of Kâlidâsa,[2] he must be placed between the 4th and 5th century. But Varâhamihira, the astronomer, is now known to have flourished in the sixth century.

Under these circumstances, the easiest explanation would of course be to ascribe the origin of the tradition to the desire of the people for a convenient mnemonic grouping together the greatest makers of national literature, art, and science through the ages, long after the great masters had played their part on the world's stage. The traditions of the seven wise men of Greece and the seven Magi of Persia afford instances of such convenient groupings of men who have lived, if they were really men of flesh and blood, ages apart from each other.

It is posterity that arranges, classifies, and systematises the exploits of the predecessors. Human memory in reconstructing the history of past generations through the dim vistas of folklores, traditions, myths and fables obliterates[3] the sharp edges of temporal and local differences; and the result is a well-rounded 'system,' a cleverly assorted 'Noah's ark,' a sweet company of 'strange bed-fellows' and a glib enumeration of facts and 'things that never were on sea or land.' Such latter-day recounting and reconstruction of the deeds of the founders of a people's greatness as are improvised for the purpose of helping the national memory and aid in the promotion of race-consciousness are not, however, without deep historical and sociological significance. For these traditions are, at any rate, replete with the associations of the epochs in which they were made and must bear the impress of the general features of the culture of the day.

Thus the metaphorical use of the doctrine of nine gems in Indian traditional thought must be ascribed to an epoch which has long been used to the idea of nine gems literally speaking. The philosophy and history of the metaphorical use must follow the philosophy and history of the tradition regarding the actual stones of the mother-earth.

The enumeration and classification of precious stones, however, have not been uniform in Indian mineralogical literature. The tradition recorded in

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[1] See the discussion in Prof. Wilson's *Viṣṇu Purâṇa* (1864) Vol. I. Preface pages vii—ix.

[2] Pandit Râmavatâra Śarmâ Sâhityâchâryya, M. A., Professor of Patna College, Bankipur, and Dr. Bloch have proved that the author of *Raghuvamsam* and *Kumârasambhavam* flourished during the reign of Chandragupta II and Kumâragupta. For an account of covert references to the Gupta Emperors, see the late Mr. Harinath Dey's English Introduction to the Bengali work on Kâlidâsa by Pandit Râjendranâth Vidyâbhushan (1908).

[3] According to tradition Kṣapaṇaka and Amarasimha were probably Jainas, Kâlidâsa belonged to the agricultural caste and Ghatakarpara was a potter, and so on.

Sukraniti about (1) the nine *mahâratnas* or great jewels (2) their grouping in order of merit into four classes, *e.g.*, (*a*) *Sresthatara* or *par excellence*, (*b*) *Srestha* or high class, (*c*) *Madhyama* or middling and (*d*) *Nicha* or inferior, and (3) the astral or mystical connexion of each with one of the nine deities presiding over, or apotheosised out of, the nine planets, is only one phase in the history of Hindu ideas about precious stones and jewels. It may be possible to fix the age of certain passages of the *Nitisâstra* of the philosophers of the Sukra cycle by tracing the history of this doctrine of nine gems.

From the close connexion of the nine gems with the nine planets it may be presumed at the outset that the origin of the tradition is to be traced to the idea of *navagraha* in the history of Hindu Astronomy. In the following account, therefore, we have to take note of two things:

(1) Changes in the ideas about the enumeration, classification, &c., of precious gems; (*a*) as *navaratna*, and (*b*) as *nava mahâratna*.

(2) History of the navagraha or nine planets: (*a*) as members of the celestial system and (*b*) as influencing things mundane, specially as presiding over the gems.

(*a*) *Vedic Literature.*

In our account of the history of Indian literature on gems we have alluded to the reference in the Vedas. But information is mostly indefinite and vague. It is only the pearls that have been distinctly mentioned, and an account of their origin given. And though jewels, like metals, are used with charms and incantations against the malevolent influences in enemies and demons, we do not meet with any trace of the connexion that exists between gems and the deities, whether powers of nature or planets and stars of the sky.

But Vedic literature is important in the history of Indian mineralogy from at least one point. We have seen that in the Vedas the generic word for metals is not *dhâtu*, but *ayas*, or *loha*. So also the gems and jewels, whether meaning thereby pearls or diamonds, are generally referred to not as *ratnas*, but as *maṇis*, though the word *ratna* does occur in the *Rig Veda*.

(*b*) *Ayurvedic Literature.*

This word *maṇi* for gems holds the ground for long. In Ayurvedic literature we find Charaka and Susruta using this term. In the introductory chapter of his work Charaka mentions *maṇis* among the drugs pertaining to the earth. We have noticed above that no gem[2] has been enumerated by name

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[1] Prof. Yoges Chandra Ray in his learned work in Bengali on the Astronomy and Astronomers of the Hindus testifies to the belief of the people in Vedic times in the influences of stars and planets on human life. "The propitiation of the *navagraha* or nine planets has been sanctioned in the Parisista of Sâma Veda."

At least about 1000 B.C. the fact that the movements of the stars governed the fate of men on earth was understood and explained. (See p. 45—Edition 1913). But no definite connexion of stars with jewels or metals is suggested.

[2] See *Charaka Samhitâ*, Sanskrit Text, p. 7 (Edited by Kavirâjas Sen, Calcutta).

in the *Charaka Samhitâ.* So this work also, like Vedic literature, does not throw much light on the doctrine of nine gems.

The information supplied by Susruta is a little more definite. He also uses the term *maṇi* and not *ratna*, and in the chapter on *Food and Drinks* in the Sutrasthâna section of the *Samhitâ* gives the medicinal properties of six gems[1] only. These are muktâ (pearls), vidruma (coral), vajra (diamond), indra (sapphire), vaiduryya (chrysoberyl) and sphatika (crystal).

The word *ratna* must have been always familiar in literary circles, Vedic and post-Vedic. Long before the days of Kâlidâsa, who uses the word frequently, Varâhamihira, who refers to many previous *Ratnaśâstras*, and Amarsimha, the lexicographer, who are generally supposed to have flourished between the 4th and 6th century A.D., the gems and precious stones have been referred to by convertible terms, *maṇi* and *ratna*.

It would thus appear that the word *ratna* as a technical term used in scientific treatises has had a longer history than *dhâtu* which, however, as a name of metals, is old enough. The term *loha* has held the ground for a longer period—even in works like Rasaratna-samuchchaya of the 14th century. But the term *maṇi* has allowed its rival *ratna*[2] to flourish parallel to itself and gradually supersede it ever since the times of Buddha, the Epics and earlier Purâṇas.

(c) *Varâhamihira.*

Besides *Susruta*, the only important work that supplies positive information on the enumeration and classification of *ratnas* or *maṇis* during the classical period[3] is that scientific work of the sixth century, the *Brihat Samhitâ* of Varâhamihira. This astronomer like, his predecessors of 1000-1500 years ago, fully believes in the mundane influences of the planets and their movements and begins his work with the following words fathered upon the sage Garga : "That prince meets with ruin who does not support a Jyotiṣaka well-versed in all the divisions and sub-divisions of Samhitâ, and in Horoscopy and Astronomy. * * * If there were no Jyotiṣakas, the muhurtas, the tithis, the nakṣatras * * would go wrong. * * * He who loves prosperity ought

[1] *Susruta Samhitâ* Edited by Kavirâjas Devendra Nath Sen and Upendra Nath Sen (1900) pp. 221-222. Susruta knows of other *maṇis* as the compound ending in *âdi* or "*etc*" implies; but perhaps does not mention them as they are not much used in medicine. Thus, as Dr. Dutt says in the *Materia Medica of the Hindus*: "of the precious stones, diamond, pearl, and coral only are much used in medicine. The rest are rarely used or not used at all," p. 92, (Edition of 1900).

[2] Messrs. Macdonell and Keith consider the word to denote any precious object in Rigveda, not necessarily a jewel, as later. *Vedic Index* II, 199. The older word *maṇi* seems to be more generic, *ratna* is the word for more precious substances. The word *maṇi* may be taken more widely, in which sense it would include *metals* on the one hand, and gems on the other.

[3] There has been very little critical study in the literature of this period, and very few materials of a historical or sociological character are at present available.

not to live in a country devoid of a Jyotiṣaka. The Jyotiṣaka[1] forms as it were the eye of the land."

Varâha then describes the seven planets and the Râhu, but does not mention the Ketu, the ninth planet. In treating of the influences of the planets Varâha does not notice the connexion that may possibly exist between the *grahas* and the *ratnas.*

When, however, towards the close of his work, he notices the gems enumerating them and describing their characteristics, he does this not because these have any natural relationship with the gems of the firmament, but because, like these celestial orbs, and so many other things in the universe, *viz.*, trees, animals, earthquakes, clouds, &c., they independently govern the destiny of mankind. According to Varâhamihira, whatever directly or indirectly affects human welfare are important items and cannot be neglected in that aspect of Jyotiṣa Sâstra which is being dealt with in *Brihat Samhitâ*. The planets have been discussed because they influence man's destiny. So also the meteorological, agricultural and other phenomena have commanded his attention. The same reasons demand of him space for the jewels and precious stones. Varâha has nothing to do with the propitiation of the planets and does not care to study the gems[2] in their special relations to the planets.

Varâha has mentioned 22 gems, but describes only four in detail:— (1) Diamond, (2) Pearls, (3) Rubies, (4) Emeralds. And he treats of the influences of these as affecting social welfare.

The object of Varâha in introducing the subject of gems[3] in the astronomical work is set forth by him at the outset: "A good gem brings prosperity to the king and a bad one brings misery. It is therefore necessary to examine the properties of gems with the help of persons learned in the science; for a person's fortune depends upon the gems he possesses. Elephants, horses and women possessed of excellent virtues are also known as gems; but diamonds and the like gems which are to be treated of in this chapter are stones and the like, possessed of many excellent qualities."

The treatment of gems in *Brihat Samhitâ* is thus quite independent of all astronomical ideas explained by the author in his last two works, *Pancha-siddhântikâ* and *Brihajjâtaka*, as well as in certain portions of this work also. The author mentions the special characteristics of such pieces of diamonds and

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[1] Varâha goes on: "Even the Mlechchhas and Yavanas who have well-studied the science are respected as Riṣis," pp. 10-11. Translation of Mr. Chidambram Iyer, B. A., Founder of Tiravadi Jotistantra Sabha (Madura, 1884).

[2] See Iyer's Brihat Samhitâ XXXIII—XXXVI (pp. 164-174).

[3] In a sense *Brihat Samhitâ* is a socio-economic treatise dealing with the manner in which the lithosphere, hydrosphere and atmosphere of the globe affect human conditions, rather than an astronomical, geographical or botanical work. It is thus to a certain extent allied to *Arthasâstra*, and closely resembles *Yukti-kalpataru* which is perhaps based upon it.

pearls as are sacred to Indra, Yama, Viṣṇu, Varuṇa and Agni, but refers to no species as the favourites of the sun or moon, etc.

The great astronomical landmark of the 6th century, therefore, does not throw any light on any one of the several problems connected with the *Doctrine of Nine Gems.* We know only that the term *ratna* is established and that the planets influence human beings.

And this is almost where Vedic literature left us.

(*d*) *The Purâṇas.*

The evidence of Amarakoṣa, the lexicon, is not much useful. Agnipurâṇa (of the 8th century?) mentions many gems, but describes only eight: vajra, marakata, padmarâga or mâṇikya (oriental ruby), uruvinda (corundum), saugandhika (spinel), muktâ, indranîla, and vaidurrya. This list differs from that in Sukra by taking corundum and spinel, but rejecting coral, agate, topaz.

Twelve gems are enumerated in the *Garuḍapurâṇa* (9th cent.?). Nine gems are mentioned as principal in the two works that follow: (1) Agastyamatam (10th century?) and (2) Viṣṇudharmottarapurâṇa (10th cent.?). Each of these treatises enumerates more than nine gems, but the first is important as having for the first time referred to the use of nine gems[1] for the propitiation of the nine planets, and the second as having enumerated the same gems as *mahâratnas* that are mentioned by Sukra. These two works thus supply two important factors contributing to the growth of the doctrine of nine gems, that is to be found in Sukranîti, *viz.*, (1) the idea that nine gems are sacred to nine grahas, and (2) the classification or appreciation of the same gems as nine 'great jewels.'

(*e*) *Sripati, the astronomer.*

The idea of *navagraha* must therefore be traced to some astronomical[2] treatise between *Brihat Samhitâ* and *Agastyamatam.* That work is the *Jyotiṣaratnamâlâ* of Srîpati, who flourished between the ages of the famous astronomers Brahmagupta (7th cent.), and Bhâskarâchâryya (11th and 12th cent.). In this treatise there is the mention of nine gems to be used in propitiating the nine planets. But Sripati's other work, *Jâtakapaddhati,* which also deals with the influences of planets on human beings mentions only seven planets.[3] In Sripati, therefore, we find both the old and the new ideas about the number and influences of planets. This self-contradiction and inconsistency are to be explained by the fact that in his time the prevalent notion about nine planets and the

[1] It gives the tests of only five gems. See the Text edited by Dr. Râmdâsa Sen. The order of consecration of gems to planets followed in this work is the same as in Sukranîti, though the interpretation of the mahâratna varies.

[2] See the Bengali work, *Astronomy and Astronomers of the Hindus,* by Prof. Yoges Chandra Ray, pp. 78-103 (Edition, 1903).

[3] See *Sripatipaddhati,* slokas 9, chapter III (Edition of Nirṇaya Sâgara Press, Bombay, 1903), p. 8.

"Mars, the Moon and Saturn have strength by night. Jupiter, the Sun, and Venus have potency by day. Mercury is strong at all times."

utility of worshipping them especially by putting on gems was too powerful to be resisted. He had to incorporate in his second work what he had rejected as unscientific in his first.

Sripati's date[1] has not been fixed beyond doubt. He may be taken to have flourished about the 10th century, in fact, to have been almost a contemporary of the authors of Agastyamatam and Visṇudharmottarapurâṇa. These two werks as well as Jyotiṣaratnamâlâ were produced in an atmosphere of the same ideas regarding gems, planets and the allied topics.

Sripati's work is important from another standpoint also. The *Jyotiṣaratnamâlâ* supplies the full astronomical text of the *Doctrine of Navaratna* that has been utilised in *toto* for the mineralogical section of the *Nitisâstra* of Sukrâchâryya. The same nine gems (but not called Mahâratnas) and the same system of consecration of each to the planets, the same system of nomenclature are to be found in both.[2] Thus, according to Sripati, people should put on the ruby for the sun, pearl for the moon, coral for Mars, emerald for Mercury, topaz for Jupiter, diamond for Venus, sapphire for Saturn, gomeda for Râhu, and vaiduryya for Ketu. This corresponds exactly to what Sukrâchâryya says in lines 84-92 of section ii of Chapter IV. The same system of consecration is followed in the astronomical work, Jâtaka-Pârijâta, which devotes the whole second chapter to a discussion of the nature and properties of planets.

It may be remarked here that the colour and lustre attributed to the nine planetary deities in the hymns called *Navagrahadhyâna* fit in exactly with those described in Sukranîti as pertaining to the gems. Again, the images of *Navagraha* found at Konaraka and near Bhuvaneswara in Orissa are said to belong to temples not earlier than the 10th century.[3] This is Dr. Râjendralâl Mitra's testimony in the *Antiquities of Orissa*. The hymns, the images, the temples, the astrological calculations as well as the evidences of Ratnasâstras—all point to the Doctrine of Navaratna not being older than the 10th century.

(*f*) *Subsequent Literature.*

Of the subsequent literature on the subject, *Yukti-kalpataru* is an important landmark. But though it is based on *Garuḍa*, *Agastya* and *Visṇudharmottara*, and though it gives details relating to enumeration, characteristics and prices of the gems, it does not supply valuable information regarding the doctrine of nine gems, as it does not treat of their astral connexions at all.

So also most of the works of the 12th and 14th centuries are not important for our purposes. But *Rasaratna-samuchchaya* of the 13th-14th century,

[1] For a discussion of dates, see Prof. Ray's *Astronomy of the Hindus*.

[2] But Sripati does not use the word *mahâratna*. Viṣṇudharmottara uses the word *mahâratna*, but his nine mahâratnas are not the same as those of Sukra. If Sripati had taken the word *mahâratna* from *Vishnudh*, his work would have been the original prototype of *Sukranîti*. As it is, it is the earliest authority for the verse in *Rasaratna-samuchhaya* about *Navaratna*.

[3] See the chapter on *Graha* in Prof. Ray's *Astronomy of the Hindus*.

which is a very important document in the literature on metals, mentions in Chapter IV, 5, that Māṇikya, muktā, vidruma (*tarkṣya, i.e.*, emerald), puṣpa, vidura (diamond), nīla (sapphire), gomeda and viduraka are successively the ratnas of the nine planets. With the exception of the new terms used in this verse, *Rasaratna-samuchchaya*[1] follows exactly the system in *Sukranīti.* This work mentions other gems as well, but regards these nine as the *navaratna par excellence.* The only point in which this differs from Sukranīti is that it does not apply the term *mahâratna* to these nine gems. The work thus fully agrees with Sripati's Jyotiṣa-Ratnamālā (10th-11th cent.).

We now come down to *Bhâvaprakâsa* of the 16th century. This work, like the one just described, continues the full tradition originating in the astrological, religious and socio-economic literature of the 9th and 10th centuries. The *Râjanighantu*[2] of the 17th century also mentions the same nine gems as sacred to the same planets.

But the classification of *navaratnas* or nine gems into grades adopted in these two works differs from that in Sukranīti. Sukrâchâryya calls all the nine gems by the name of *mahâratnas.* But *Bhâvaprakâsa*[3] and the *Râjanighantu* mention five of them only as *mahâratnas* and call the rest *uparatnas* (inferior gems).

(g) *Recapitulation.*

The historical inquiry into the doctrine of nine gems leads to the following conclusions about the age of the section in *Sukranīti* dealing with gems :

1. The Sukra authors do not display astrological conceptions prior to or even contemporaneous with, those of Varâhamihira (6th cent. A.D.).

2. The doctrine embodied in Sukranīti bears the influence of the following ideas :

(i) The enumeration and appreciation of gems as nine *mahâratnas*[4] adopted by the author of *Viṣṇudharmottarapurâṇa* (10th cent. ?) who quotes *Garuḍa.*

(ii) The system of consecration of the nine gems (not necessarily mahâratnas) to the nine planets followed in *Agastyamatam* (which is probably earlier than Viṣṇudharmottara, but belongs to the same age); as well as in Rasaratna-samuchchaya.

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[1] See Sanskrit Text of the work edited and published by the Anandâsram, Poona, pages 10-12.

[2] See the Hindi Edition (Benares), p. 140.

[3] See *Viswakoṣa* (Vasu's) Vol. IX, (navaratna).

[4] Nine gems are mentioned in (1) Agastya, (2) Viṣṇudharmottara, (3) Jyotiṣaratnamâlâ, (4) Sukranīti, (5) Rasaratna-samuchchaya, (6) Bhâvaprakâsa, (7) Râjanighantu.

Nine mahâratnas are mentioned only in (1) Viṣṇudharmottara and (2) Sukranīti; but the list is not the same in the two works. See the original text of Viṣṇudharmottara quoted in Dr. Sen's *Ratnarahasya.*

(iii) The recognition of Râhu and Ketu as the two additional Grahas who should be worshipped along with the old seven, first noticed in the second work of the astrologer, Srîpati, which, however, he had ignored in his earlier work.

3. The doctrine is certainly older than the tradition embodied in Bhâvaprakâsa and Râjanighantu (16th and 17th cent.).

4. The doctrine in all particulars cannot be traced to any work on the subject, and has not been copied in *toto* in any work that we know of. Sukranîti is *sui generis* in this respect.

The date of the second work of Sripati, *viz.*, *Jyotiṣaratnamâlâ* may thus be assigned to be the extreme upward limit of the Doctrine of *Navaratna*, as it contains the first literary evidence of *Navagraha*. This must be placed sometime in the 10th century A.D.

The mineralogical section of *Sukranîti* thus yields two furthest limits of chronology: (1) the 10th century—furnished by the doctrine of nine gems, and (2) the 14th century--furnished by the doctrine of seven metals.

There is one difficulty that remains to be explained. If the doctrine of nine planets be the basis of the doctrine of nine gems, we might expect also a doctrine of nine metals. But, though *Sukranîti* mentions altogether nine metals, it recognises only seven as principal. Or, if the doctrine of seven metals has something to do with the original seven planets, we might expect a corresponding Doctrine of Seven Gems as well. But in India the metals seem to have had no connexion with planets even up to 14th century, as has been discussed in the section on the doctrine of seven metals.

SECTION II.

The Economic Mineralogy of Sukrâchâryya's India.

The Mahâratnas.

Sukrâchâryya divides the nine great gems into the following four classes in order of merit:—

(1) Vajra, being *Sreṣṭhatara*, by far the best;
(2) Good or *Sreṣṭha:* (i) Marakata, (ii) Mânikya, (iii) Muktâ;
(3) Middling or *Madhyama*: (i) Indranîla, (ii) Puṣyarâga, (iii) Vaiduryya;
(4) Inferior or *Nîcha*: (i) Gomeda, (ii) Vidruma or Pravâla.

i. Vajra or Diamond.

This gem is the favourite of the poet, *viz.*, Sukra[1] who is the preceptor of the Asuras and the author of our *Nîtisâstra*. It is very transparent and has the lustre of the star.

This is the best gem.[2] The popular notion about it is that the woman[3] who wants a son should never wear a diamond. This is perhaps one of the hard

[1] Sukra IV, ii, 89. [2] Sukra IV, ii, 93. [3] Sukra IV, 105.

substances which are to be used in cutting[1] or writing upon gems. But it is to be noted that only pearls and corals can be thus incised.

The value of this gem in terms of "money" is given below :—

(1) "The price[2] of one whole diamond weighing one *rati*, but wide in extent, is five *suvarnas* or gold coins.

(2) "The price is five times (*i.e.*, twenty-five gold coins), if it be heavier than one *rati* and superior in extent.

(3) "The price is to be less and less according as the quality falls off."

This is according to the general theory that small weight but large bulk are the conditions of the high worth of jewels. The value may be expressed in terms of *rati* in the following way: "Eight *ratis*[3] make one mâṣâ, ten mâṣâs make one *suvarṇa*." Thus 80 *ratis* make 1 gold coin : therefore 400 *ratis* make 5 gold coins. The ratio of diamond to gold, as expressed in the above extracts, would therefore be 1 to 400; or "exchange-value" of diamond is 400 times that of gold.

This general ratio is to be modified by the following considerations:

(1) Other things remaining the same, the exchange-value[4] is (*a*) one-third less than the above (which determines the 'normal' or 'natural' value), if the stone be flat-shaped, (*b*) one-half, if the stone has the colour of the reddish powder of bricks. [In the general remarks on the value of gems we noticed that this colour is not appreciated.]

(2) Other things remaining the same, the 'exchange-value' (*a*) would be half, if two pieces together[5] weigh one *rati*; (*b*) half of this (*i.e.*, one-fourth of the 'normal'), if the stones be middling or inferior.

(3) Other things remaining the same, the exchange-value of inferior or middling qualities would be determined in the following manner:[6] (*a*) By multiplying the weight in *ratis* by nine-sixteenth. (*b*) By adding together five-sixteenths and one-thirtieth.

The general rule about the determination of the 'money-value,' *i.e.*, price and 'exchange-value' of diamond is given in the following lines:

(1) The value of diamond is according to its *weight* in terms of *rati*.[7] (2) Even in the case of small pieces, the *weight*[8] has to be considered, not number (as with other gems).

[1] Sukra IV, ii, 109-110, "The gems cannot be cut or written upon by iron or stones (diamonds) except pearls and corals." See p. 142 of my translation of *Sukraniti* in the *Sacred Books of the Hindus Series*.

[2] Sukra IV, ii, 134-137

[3] Sukra IV, ii, 138.

[4] Sukra IV, ii, 140-142.

[5] Sukra IV, ii, 143-144.

[6] Sukra IV, ii, 146-148. Specialists would do well to verify the truth and propriety of these remarks. The comparative prices given here would be discussed in the chapters on the *Data of Ancient Indian Economics* and *Public Finance*.

[7] Sukra IV, ii, 140-142,

[8] Sukra IV, ii, 163,

"In India diamonds occur over three wide areas: (1) the eastern side of the Deccan from the Penner to the Sone, (2) the Madras Presidency, especially in Kistna and Godavari basins, and (3) Chutia Nagpore and Central Provinces to Bundelkhand. It is somewhat remarkable that the Indian diamonds have not as yet been found in what can be called their original matrix. * * * None of the Indian diamond fields can, at the present day, be viewed as of commercial importance, and it is difficult, if not impossible, to identify for certain, all the localities alluded to by classical writers. * * * India was the first and for a long period the only source of diamonds known to the European nations. * * * It appears to have been worn by the nobility of India long anterior to the earliest European mention of it. * * * Tavernier was perhaps the first European who travelled over India with the express purpose of inspecting diamond mines."[1]

The legend of the origin of *Kohinur*[2] is that it was found in the mines of the south of India, and was worn by one of the heroes of the *Mahâbhârata*, Karṇa, king of Anga; this would place it about 5000 years ago, or 3001 B. C. Nothing more of it is heard till it appears as the property of Vikramâditya, &c.

ii. Muktâ or Pearls

This is the favourite of the moon,[3] *i.e.*, presided over by this planetary deity, and may have red, yellow, white and syâma (swarthy or greenish blue) colour.

This gem is lower in value than diamond, but superior to the lowest, *viz.*, *gomeda* and *vidruma*, as well as to *indranîla*, *puṣyarâga* and *vaiduryya*, which are middling stones. One characteristic of this jewel is that it can be written upon (like corals) by iron or stones.[4]

In the section on general remarks we noticed that gems cannot deteriorate in value except through the wickedness of kings. But pearls and corals are to be exempted from this generalisation, for they do fade through use[5] in time. The deterioration comes in naturally.

The following are the sources[6] of pearls recorded in *Sukraniti*: (1) fishes, (2) snakes, (3) conches, (4) boars, (5) bamboos, (6) clouds, (7) oyster-shells. The greatest amount is said to come from these last.

This last class of pearls is divided into three grades:[7] (1) inferior, (2) middling and (3) excellent. It is only these pearls, again *i.e.*, those derived from shells as mothers that can be pierced[8] and hence used in ornaments. Those coming from others cannot.

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[1] *Dictionary of Economic Products of India*, pp. 93-101, Vol. III (1890).

[2] See *Note on the History of the Kohinur Diamond* in *Handbook of the Manufactures and Arts of the Punjab*. By Baden Powell (1872), pp. 195-201.

[3] Sukra IV, ii, 85.

[4] Sukra IV, ii, 109-110.

[5] Sukra IV, ii, 106.

[6] Sukra IV, ii, 117-118.

[7] Sukra IV, ii, 122.

[8] Sukra IV, ii, 123. See account of pearl-boring in Baden Powell's *Punjab Manufactures*, p. 192 (1872).

And the people of Ceylon [1] can make artificial pearls like those from shells. One should therefore carefully examine pearls before purchasing them.

The test[2] is given below: "That certainly is not artificial which does not lose colour by being rubbed with *vrihi* paddy after having been soaked in hot saline water during the night. If it remains very bright it is really derived from shells. If it has middling lustre, it is otherwise."

The *Garuḍapurâṇa*[3] and *Yukti-kalpataru*[4] also describe the industry of the Ceylonese in artificial Pearl-manufacture. *Brihat Saṃhitâ*, *Garuḍapurâṇa* and *Yukti-kalpataru* mention Ceylon, Pâralaukika, Saurâstra (Guzrat), Tâmraparṇi (Malabar), Persia, Kouvera, Pâṇdyavâtaka, and Haimadesa as the eight regions where oyster-pearls are found. According to *Agastyamatam* the places are Ceylon, Arabia, Persia, and Barbara (North Africa).

The following list of pearls is given in order of excellence,[5] the first being the best:—

(*a*) As regards layers or skins:

(1) Those with seven skins or coverings.
(2) Those with five or four skins.
(3) Those with three or two skins.

(*b*) As regards colour: (?)

(1) Red.
(2) Yellow.
(3) White.
(4) Black.

The following is the order of age,[6] the first being the oldest: (?)

(1) Yellow.
(2) Red.
(3) White.
(4) Black.

Both these lists apply only to the pearls derived from oyster-shells.

In connexion with the value of pearls the following things are to be noted:

(1) The *rati* for the measurement[7] of pearls is not the same as that for diamond and other stones. For all gems twenty *Kṣumâs* make one *rati*; but for pearls three *ratis* are made by four *Krisṇalas*; and twenty-four *ratis* make one *Ratnatanka*.

[1] Sukra IV, ii, 124-125.
[2] Sukra IV, ii, 126-128. Specialists may verify it.
[3] Quoted by Prof. Yoges Chandra Ray in *Ratnaparîkṣâ*.
[4] Quoted by Dr. Râmadasa Sen in *Ratnarahasya*.
[5] Sukra IV, ii, 119-120. The correctness of the order may be tested by specialists.
[6] Sukra IV, ii, 121.
[7] Sukra IV, ii, 130-132.

Now as 4 *tankas* [1] make 1 tola of gold, 96 *ratis* (Pearl-standard) make 1 tola of gold.

(2) The exchange-value of pearls varies according as the substance is of inferior, middling, and superior grades.[2]

(3) The standard is either diamond[3] or gold.[4]

The following are the methods prescribed for the calculation of the prices of pearls :—

(*a*) According to Diamond-standard :

(1) If the pearl is of more than a thousand *ratis* in weight, then for every hundred *ratis*, the value would be the same as of a diamond, less three hundred, divided by sixteen. (?)

(2) If the pearl is more than hundred *ratis* in weight, then from every hundred *ratis* deduct twenty *ratis*, and after such deduction the value of each *rati* would be the same as that of the diamond of the first class. Thus if the weight of pearls be 200 *ratis*, the price will be calculated after a deduction of 20 per cent. from the weight, *i.e.*, upon the weight of 160 *ratis*.

(*b*) According to the Gold-standard :

Multiply the weight[5] of the pearls in *ratis* by $13\frac{3}{4}$ and divide the product by 24, the quotient will be the value of the pearl in so many *ratis* of gold.

The following are some general remarks[7] about the worth of pearls :

(1) The best pearls are valued at half the price of gold.

(2) The best pearls are the red, yellow, round and white.

(3) The worst are the flat ones and those having the lustre of powdered bricks.

(4) The rest are middling.

"Tuticorin has been celebrated for its pearl-fishery[8] from a remote date, and as regards comparatively modern times, Friar Jordanus, a Missionary Bishop, who visited India about the year 1330, tells us that as many as 8,000 boats were then engaged in the pearl-fisheries of Tinnevelly and Ceylon."

Megasthenes' account of Indian Pearls can be gleaned from Arrian's *Indica* (VII—IX) and Pliny's *Natural History* (IX, 55). From the Bengali translation of the Greek original of Megasthenes by Prof. Guha we gather that pearl-fishery was only an application of the ordinary principles of the Fishing Industry. It was known that the oyster shells or the mothers-of-pearls lived in shoals like fishes, and resembled the community of bees with a ruling queen. If the chief

[1] Sukra IV, ii, 133.
[2] Sukra IV, ii, 140.
[3] Sukra IV, ii, 140-151.
[4] Sukra IV, ii, 166-170.
[5] Sukra IV, ii, 152-154.
[6] Sukra IV, ii, 166-167.
[7] Sukra IV, ii, 168-170.

[8] Pearl and Chank Fisheries of the Gulf of Manaar, by Thurston, Superintendent, Madras Government Museum, p. 9.

could be caught the whole group of oysters fell an easy prey. The shells were kept in a vessel full of salts for some time until the fleshy portion decomposed of itself. The bony portion, the pearls, was then ready for use.

According to Megasthenes the value of pearls was equal to three times that of pure gold of the same weight.

iii. Mâṇikya or Ruby.

This is the sun's favourite,[1] of red colour, and has the bright lustre of *indragopa* insect. This belongs to the class of gems intermediate[2] between *vajra*, the best, and the middling ones. It is, therefore, appreciated equally with pearls and emeralds. The comparative values are not stated. We are told simply, as we have seen, that the emerald, if it is good, deserves the price of a ruby.[3] There is one more information about *mâṇikya*, *viz.*, that regarding *padmarâga*,[4] which is said to be one of its varieties and has the lustre of red lotus.

"The name[5] is applied by lapidaries and jewellers to two distinct minerals—the true or oriental ruby and spinel ruby. The former may be called a red variety of corundum, is aluminic oxide. The spinel ruby is an aluminate of magnesium. * * * The ruby receives the name "oriental" from the fact of the finest red and violet varieties being obtained from Ceylon, Ava and other parts of the East."

"The delicate[6] rose pink variety of spinel, known as balas ruby, was worked for centuries in Badakshan. In the time of Marco Polo the mines were wholly in the hands of the king of Balkh.

"The chief sources, however, both of the oriental and the spinel ruby are the mines of Upper Burma. * * * The ruby mines of Burma were first made known by European travellers towards the end of the fifteenth century * * * rubies come next in value to diamonds. * * Like most other jewels, rubies have some fancied talismanic virtues attached to them. In many parts of India a bracelet formed of nine gems, of which the ruby is one, is supposed to protect the wearer from the evil eye."

iv. Pâchi, Marakata, Gârutmata or Emerald.

This is the favourite of the planetary deity Mercury.[7] It has the lustre of the feathers of the peacock or of the *châsha* (nîlakaṇṭha) bird.

This belongs to the class of pearls and *mâṇikya*,[8] *i.e.*, just inferior to the *vajra* or diamond and superior to the middling class. If the *gârutmata* is good, it deserves the price of a mâṇikya or ruby.[9]

According to *Garuḍapurâṇa* and *Agastyamatam* the source of this gem is Turkey. According to *Ratnasaṃgraha* it is *Mlechchhadesa.*

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[1] Sukra IV, ii, 84.
[2] Sukra IV, ii, 93-95.
[3] Sukra IV, ii, 157.
[4] Sukra IV, ii, 104
[5] Encyclopædia Britannica—Chemistry.
[6] *Dictionary of the Economic Products of India* (1892), Vol. VI, Part 1, pp. 584-589.
[7] Sukra IV, ii, 87.
[8] Sukra IV, ii, 93-95.
[9] Sukra IV, ii, 157.

v. Indranīla or Sapphire.

This is the Saturn's favourite,[1] is not white, but has the colour of deep clouds (blue). This belongs to the *madhyama*[2] or middling class of gems, like *puṣyarâga* and *vaiduryya, i.e.,* just superior to the lowest class comprising *gomeda* and *pravâla.* The value of indranīla is perhaps the same as that of gold, as can be guessed from the following: "The *puṣyarâga* weghing one *rati* deserves half the price of *indranīla*[3] or gold (of the same weight).

"It is classed[4] with 'gems or precious stones' in contradistinction to the 'inferior gems.' It is a blue transparent variety of corundum ($Al_2 O_3$) and differs from the oriental ruby merely in its colour. * * * Sapphires of various colours occur in India. * * * Sapphire is found along with many other varieties of corundum in the ruby mines of Upper Burma. * * In Ceylon * * sapphires are found frequently. In 1882 a remarkable discovery of sapphires was made in Kashmir territory."

vi. Vaiduryya.

Prof. Yoges Chandra Ray considers this to be chrysoberyl (oriental cat's eye), Wilson takes it for *lapis lazuli.*

This is the Ketu's favourite.[5] has the lustre of cat's eyes and has its particles moving.

Like *indranīla* it belongs to the middling class of gems.[6] That piece whose three rays are coming out deserves high price.[7] Comparative values are not given.

vii. Puṣyarâga or Topaz.

This is the favourite of Jupiter[8] and has the brilliancy of gold. It belongs to the middling class[9] of gems.

The piece weighing one *rati* deserves, as has been quoted above, half the price of gold or sapphire of the same weight.[10]

"It may be defined[11] as a fluosilicate of aluminia ($Al_2 O_5 Si$). * * The oriental topaz is in reality a yellow sapphire or corundum. Of the occurrence of topaz in India, Ball says, "there appears to be no authentic record, a reported discovery in the basalt of the Rajmahal hills being open to question. Ceylon, it is believed, yields a not inconsiderable proportion of the topaz of commerce."

According to *Garuḍapurâṇa* the source is Himâlaya; according to *Ratnasamgraha,* it is *Karka* and Ceylon.

viii. Gomeda.

It is difficult to identify it. It is agate according to Wilson,[12] but zircon according to Yoges Chandra Ray. Information about this is as meagre as about coral in *Sukranīti.*

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[1] Sukra IV, ii, 90. [2] Sukra IV, ii, 95. [3] Sukra IV, ii, 159.

[4] *Dictionary of the Economic Products of India*, pp. 474–475, Vol. VI, Part II.

[5] Sukra IV, ii, 92. [6] Sukra IV, ii, 83.

[7] Sukra IV, ii, 94. [8] Sukra IV, ii, 94.

[9] Sukra IV, ii, 160. [10] Sukra IV, ii, 150.

[11] *Dictionary of the Economic Products of India* (1898), p. 70, Vol. VI, Part IV.

[12] Wilson describes it as a stone brought from the Himalaya and the Indus, having four different colours, *e.g.*, white, pale-yellow, red and dark-blue.

It is the Râhu's favourite,[1] and like coral has yellowish red or orange colour. Like coral again it belongs to the lowest class.[2] Its value is not[3] to be determined by weight like that of all other gems. It does not deserve[4] weighing, as it is very low-priced.

The region is Himâlaya and Sindhu according to *Yukti-kalpataru.*

ix. Pravâla, Vidruma or Coral.

This is the favourite gem of Mars [5] and has yellowish red colour. Like *gomeda*, it is one of the lowest *ratnas.*

It fades through use[6] in time. Like pearls, corals can be cut or written upon[7] by iron and stones (*e.g.*, diamonds). Corals weighing one *tola* deserve half the price of the gold of the same weight.[8]

"In addition [9] to being used for adornment ornamental corals have been used in Hindu medicine from a very ancient time and are mentioned by Susruta. Ainslie remarks that the Tamil practitioners prescribe the red coral when calcined in cases of diabetes and bleeding piles."

SECTION 12.

Miscellaneous.

There are certain substances more or less allied to those dealt with in this chapter that have been referred to by the authors of the Sukra cycle in their description of the kalâs, the artisans, the industries and the Ordnance Department. These should be noted in an account of the mineralogical data available from the *Sukranîti.*

One of the general rules for the guidance of kings is that they should accumulate for future purposes such things as are useful to man. Among these are mentioned minerals,[10] implements, arms, weapons, gunpowder, vessels, etc.

1. *Sulphur.*

Sulphur[11] has been mentioned as an ingredient of gunpowder.[12] The following are the recipes for this preparation :

(1) Five *palas*[13] of *suvarchi* salt (saltpetre), one *pala* of sulphur, and one

[1] Sukra IV, ii, 91.
[2] Sukra IV, ii, 93-95.
[3] Sukra IV, ii, 120.
[4] Sukra IV, ii, 102.
[5] Sukra IV, ii, 86.
[6] Sukra IV, ii, 106, 115-116.
[7] Sukra IV, ii, 100-110. The reader is requested to note the change in the translation given here from that given on p.142 of the Vol. XIII of the *Sacred Books of the Hindus Series.*
[8] Sukra IV, ii, 101.
[9] *Dictionary of the Economic Products of India*, p. 582, Vol. II (1889).
[10] Sukra IV, ii, 60-63.
[11] The use of sulphur in medicines as copper sulphate, and iron sulphate (copperas) is as old as *Charaka Samhitâ.*
[12] Dr. Râjendralâl Mitra, who discovered the *Sukranîti* in 1875, doubts the authenticity of these lines (vide *Indo-Aryans*, Vol. I, pp. 309-12). But Dr. Gustav Oppert, who edited and published the Text for the Madras Government in 1882, proves by quotations from Vedas, Asoka's Edicts &c., that "firearms and gunpowder existed in Ancient India." See his preface to *Sukranîti* published by Madras Government, also his essays on the authenticity of Sukranîti, and *Firearms and weapons in Ancient India* published by Higginbotham & Co., Madras (1880).
[13] Sukra IV, vii, 400-404.

pala of charcoal from the wood of *arka* (Calotropis gigantea), *snuhi* (Euphorbia neriifolia) and other trees burnt in a manner that prevents the escape of smoke have to be purified, powdered, and mixed together, then dissolved in the juices of *snuhi*, *arka*, and garlic (Allium sativum), then dried up by heat, and finally powdered like sugar.

(2) Six or four parts[1] of saltpetre may also be used in the preparation of gunpowder. Sulphur and charcoal would remain the same.

(3) Experts make gunpowders in various ways[2] and of white and other colours according to the relative quantities of constituents :—Charcoal, sulphur, saltpetre, stones, *haritâl* (orpiment)[3] lead, *hingul*, iron calces (oxides), camphor, *jatu* (lac), indigo, juice of *sarala* tree (Pinus longifolia).

The use of salts, *e.g.*, Suvarchi or saltpetre,[4] has been referred to in the above recipes.

The mention of sulphur introduces us to a fact of great economic importance, and furnishes a solid basis for interpreting certain phases in the industrial history of India. "Chemical and metallurgical industries," says Mr. Holland, Director of the Geological Survey of India,

"are essentially gregarious in their habits. * * * The bye-product is a serious and indispensable item in the sources of profit, and the failure to utilise bye-products necessarily involves neglect of the minerals which will not pay to work for the metal alone."

The demand for sulphur in ancient India and the consequent supply of it in response necessarily involved, according to this 'principle of association' which is really an aspect of the Doctrine of the "Localisation[5] of Industries," a good number of auxiliary and allied industries in mining, metallurgy and manufacture, utilising the bye-products. The fact that there are no such auxiliary industries in modern India is the real explanation, according to Mr. Holland, of why a good many otherwise rich metalliferous ores cannot be worked.

We can easily turn this economic fact of modern times to account in understanding the industrial situation of the country in by-gone days. Thus we are led to infer the existence in ancient India, side by side with the sulphur industry, of all those to which it is a key. Says Mr. Holland:

"Sulphuric acid is essential for the manufacture of sulphur-phosphates, the purification of mineral oils and the production of ammonium sulphates, various acids, and a host of minor products; it is a necessary link in the chain of operations involved in the manufacture of the alkalies, with which are bound up the industries of making soap, glass,

[1] Sukra IV, vii, 405-406.

[2] Sukra IV, vii, 411-415.

[3] "Most of the older Sanskrit MSS. are written on paper prepared with haritâla to preserve them from the ravages of insects, and this it does most effectually"—Dutt. Dr. Mitra also describes arsenicised paper in his report on Sanskrit MSS. in the proceedings of the Asiatic Society for March, 1875.

[4] This salt has been mentioned in *Charaka Samhitâ* and *Susruta Samhita* also.

[5] Illustrated in modern Europe by the contiguity of Iron and Coal Industry. "Many of the most profitable copper mines in the world could not be worked but for the demand for sulphur in sulphuric acid manufacture, and for sulphuric acid there would be no demand but for a string of other chemical industries in which it is used."

paper, oils, dyes, and colouring matters ; and as a bye-product it permits the remunerative smelting of ores which it would be impossible otherwise to develop."

Industry in ancient India must therefore have been more richly diversified than at present. In fact, the extinction of several industries in modern India is explained by Mr. Holland in the following lines :

"During the last hundred years the cost of a ton of sulphuric acid in England has been reduced from £30 to under £2, and it is in consequence of the attendant revolution in the Europen chemical industries, aided by increased facilities for transport, that in India the manufactures of alum, copporas, blue vitriol, and alkalies have been all but exterminated ; that the export trade in nitre has been reduced instead of developed ; that copper and several other metals are no longer smelted ; that the country is robbed every year of nearly 1,00,000 tons of phosphatic fertilisers, and that it is compelled to pay over 10 million sterling for products obtained in Europe from minerals* identical with those lying idle in India." [1]

And this state will continue "until industries arise demanding a sufficient number of chemical products to complete an economic cycle."

Exactly the reverse must have been the condition of manufacture and commerce in ancient India, and for the opposite reasons.

In the Economic Volume[2] of *the Indian Empire*, also, in the *Imperial Gasetteer of India Sries*, Mr. Holland harps on this decline of ancient chemical industries :

"In this respect India of to-day stands in contrast to the India of a century ago. The European chemist, armed with the cheap supplies of sulphuric acid and alkali * * * has been enabled to stamp out, in all but remote localities, the once flourishing native manufactures of alum, the various alkaline compounds, blue vitriol, copperas, copper, lead, steel and iron, and seriously to curtail the export trade in nitre and borax. The high quality of the native-made iron, the early anticipation of the processes[3] now employed in Europe for the manufacture of high class steels and the artistic products in copper and brass gave the country a prominent position in the ancient metallurgical world, while as a chief source of nitre India held a position of peculiar political importance, until less than forty years ago, the chemical manufacturer of Europe found, among his bye-products, cheaper and more effective compounds for the manufacture of explosives."

2. *Glass.*

Râjendralâl says that the word Kâcha for glass occurs in works considerably over 2,000 years ; and " seeing that the Singhalese who borrowed all the arts of civilised life from the Hindus, make mention, in the *Dipavamsa*, of a glass pinnacle, in the 2nd cent. B. C., and of a glass mirror in the 3rd cent. B. C. (Tennent's Ceylon I, 454), and Pliny describes the glass of India being superior to all others from the circumstance of its being made of pounded crystal it would not be presumptuous to believe that it was in ancient times used in India in the formation of looking glasses."

In *Indo-Aryans* Vol. I, Dr. Râjendralâl also refers to the knowledge which the Hindus had of glass as a material for the fabrication of ornaments ;

[1] Review of the Mineral Production of India during the years 1898-1903 By T. H. Holland, F.R.S. (1905), see pp. 7-8, 117.

[2] Chapter III, Mines and Minerals, p. 129 (Oxford, 1907).

* See *Hindu Chemistry*, Vol. II., for Seal's account of Hindu achievements in chemical industry.

but from a passage in the *Yukti-kalpataru* it appears that it was also used for drinking cups or tumblers, the physiological effect of drinking water from vessels of glass being described to be similar to that of vessels made of crystal.

In *Sukraniti* Glass has been mentioned only once. The making of glass[1] vessels is a *kalâ.*

About the antiquity of glass in India, Mr. Jayaswal remarks in reviewing Dr. Schoff's *Periplus* for the *Modern Review*:

"*Glass* in India was a manufacture long before it became known to Ceylon (3rd century B.C.,) The Artha-Sâstra calls false gems "glass-gems," and mentions the manufacture of glass. Pliny's description that the glass of India was superior to all others, because it was "made of pounded crystal" and because of the discovery made by the Hindus of the art of colouring crystal, indicates a long previous history of the industry in this country. Coloured glass was well-known to the Artha-Sâstra. The glass-worker, called at present *Maniyâra*, is mentioned by the very name (Manikâra) in the Mahâvastu.

The following are the remarks of Dobbs :

"The manufacture of glass[2] was known in ancient India as early as 800 B.C., for in *Yajurveda* glass is mentioned as one of the articles of which female ornaments were made. It is also noticed in the *Mahâbhârata*, and in an old book called the *Yukti-kalpataru* that the effects on the human system of drinking water out of a glass tumbler are stated to be the same as those of drinking out of a crystal cup. In more recent times, in the 10th century, the glass of India is said to have been exported in large quantities to Europe, and in the north of Italy there is a tradition that the Venetians at one time obtained, if not their raw glass at least its ingredients, from the plains of Hindusthan."

Mr. Taw Sein-kaw also bears testimony to the antiquity of Indian pottery, both glazed and earthen, and to its having influenced the pottery and glassware of Burma.[3] "The ceramic art did not achieve any public recognition in Europe till the 16th century A. D., but long before that period the pottery of Burma had become famous." Ibn Batuta, the celebrated Arabian traveller of the 14th century, also recorded the fact.

In Yub's *Hobson-Jobson* we have the following :—

"In this town of Martaban (now a small village in Amherst district) are made very large and beautiful porcelain vases, and some of glazed earthenware of a black colour, which are highly valued among the Moors, and they export them as merchandise."

And Mr. Seinkaw observes that Taikkalâ, one of the most important seaports of the country governed by the rulers of Martaban :

"was colonised, (as the name implies), by the Gaudas of the ancient city of Gour in Bengal. On the site of this historic Taikkalâ, traces of a wall and moat still exist, and fragments of pottery and glazed tiles are found."

3. *Alkalies.*

Alkalies also have been mentioned in *Sukraniti* as *Kṣâras*. Thus one of the 64[4] arts or *kalâs* is the extraction or preparation of alkalies. Government

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[1] Sukra IV, iii, 191.

[2] See *Monograph on the Pottery and Glass Industries of the North-Western Provinces and Oudh* by Dobbs (1895, Chapter IX, p. 29).

[3] *Monograph on the Pottery and Glass ware of Burma* (1894-95), pp. 2-3.

[4] Sukra IV, iii, 150.

revenue from this chemical industry is declared to be one-half[1] of the produce after the costs have been met.

4. *Stones.*

Stones have been referred to several times. We have just seen that these may be used as ingredients for gunpowder. Their use in statuary, iconography, and sculpture has been mentioned by the Sukra authors in their description of the images of gods. We have already alluded to this in connexion with metals.

We are told that stones are next in importance to metals in the construction of images in point of durability,[2] and superior to all other materials, *e.g.*, sands, pastes, paints, enamels, earth, wood, &c. The responsibility of the sculptor, therefore, is very great. For he must have to be well up in the conventions of the art. His workmanship would not be appreciated unless it conforms to the exact rules laid down by the masters of *Silpasâstras.*

The images that are made of less durable material are not examined by people very critically, and hence may be executed without particular care. But stone being a durable material involves on the artist an extra amount of carefulness.

But such stones as are found in hills and rivers may be used for religious purposes without human art being made to work upon them. Defects of[3] measurement are not to be noticed in such images, *e.g.*, the natural *Vânalingas* of the *Narmadâ* valley, Chandrakânta gems, or stones found in the Gandaka river.

When stone images are constructed the worshippers should observe a rule with regard to the colour of the material used. "The white stone[4] is prescribed for the Satyayuga as indicating *sâttwika* type of images, the yellow and red stones are prescribed for Tretâyuga and Dwâparayuga respectively as indicating *râjasika* type, and the black stones for the Kaliyuga as indicating *tâmasika* type. These types of images will be discussed in a subsequent chapter.

Image worship being a universal feature of Indian religious life, the industry connected with stones must be expected to have been a very rich one in the days of Sukra authors, as in all ages in Indian history. Not in religious life only, but in other departments of the social life of the people also, stone-quarrying, stone-carving, stone-inlaying as well as other industries and fine arts connected with the manipulation of sandstones, building stone, granite and marble, have played a conspicuous part. Hence in *Sukranîti* we find that among the sixty-four *kalâs* there is one connected with stones.[5]

1 Sukra IV, ii, 233-35.
2 Sukra IV, iv, 150-151.
3 Sukra IV, iv, 305-308.
4 Sukra IV, iv, 310-313.
5 Sukra IV, iii, 167-168.

This consists in the art of cleansing, polishing, dyeing, rinsing, &c., of stone vessels. There is another art also mentioned by Sukrâchâryya as being an auxiliary of Ayurveda. This is the melting and incineration of stones.[1]

Again, stone-carvers[2] are sufficiently important to be recognised by the statesmen of the Sukra cycle in their enumeration of the artists and artisans whom the state should " protect " by finding suitable employment.

It is stated by Fergusson that there is no stone architecture in India earlier than the 3rd century B.C. But says Mr. Crosthwaite :[3]

"The negative fact that no stone architecture previous to Aśoka has yet been discovered, does not justify the positive conclusion arrived at by Fergusson. * * * The famous Sâranâth stupa and the stupa near Kasia in Gorakhpur are even older than the 3rd century B.C. The excavation of a stupa at Piprahwa in Basti District yielded a casket bearing an inscription in the charactor of the 3rd or 4th century B.C. * * * The stone mason's art must have existed in India for some centuries before Aśoka's reign."

The following refers to Southern India :

" Early stone-carving reached a high degree of perfection, first under the Buddhists in India and even sometime before it,[4] * * * following the Buddhists each successive Hindu dynasty left examples of their particular styles. * * * Towards the end of the Hindu period the Vijayanagara kings were the greatest patrons of stone-carving.

"The perfection[5] to which the art of stone-carving was carried and the proportions attained by the industry can be readily, if roughly, gauged by the extent of the architectural remains still in existence, and the profusion and finish of the ornamental work with which they are enriched. The proportion which the decorative industry bore to the constructive defies accurate computation, but judged by European standards it must have been extraordinarily high."

Mr. Vincent Smith[6] testifies to the skill of Hindu lapidaries :

"Hindus, as Mr. King observes, were among the earliest of mankind to attain to mechanical perfection and facility in the treatment of the hardest stones, executing with facility many operations which would baffle the skill of the most expert modern lapidary; such as boring fine holes with the greatest precision, not merely through the sardonyx, but even through the sapphire and the ruby. All considerable collections of Indian antiquities comprise numerous specimens of pierced beads made of various precious and semi-precious stones, which display the complete mastery of the old craftsmen over the most different material."

Regarding the use of stones in the manufacture of sofas, chairs, benches, etc., in Hindu India, the following is quoted from *Indo-Aryans* :[7] "Of stones, the gritty sandstone alone was condemned, and the other kinds recommended, with the proviso that the colour of the stone should correspond with that of the planet which presided for the time being on the destiny of the person who

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[1] Sukra IV, iii, 145.

[2] Sukra II, 397-398.

[3] Monograph on Stone Carving (1906).

[4] *Monograph on Stone-carving and Inlaying in Southern India* by Rea (1906).

[5] *Stone-carving and Inlaying in the Bombay Presidency* by Tupper (1906).

[6] History of Fine Art, p. 355.

[7] Sukra I, 252-58.

was to use the seat; thus when a man happened to be under the influence of Saturn, he had to use a stone seat of a blue colour, but if Venus happened to be the presiding planet, a bright yellow stone was the most appropriate."

Regarding evidences for the treatment of stones in Hindu Architecture and Sculpture, besides the works of the historians of Indian Art, previously referred to several times, some of the unpublished collections of private associations in Bengal deserve a special mention. Such literary bodies are the Bangīya Sâhitya Pariṣat of Calcutta, Rangpur Sâhitya Pariṣat, Dacca Sâhitya Pariṣat, etc., and District Council of National Education, Malda, whose collections[1] of Gauḍa and Pandua relics were exhibited by the distinguished antiquarian, Râdhes Chandra Seth, at a conference of the men of letters belonging to North Bengal. But the most considerable are the recent finds of the Varendra Research Society in Râjsâhi. All these stones have opened up a new field for students of Indian art-culture and archæology.

The explorations of this last academy have presented us with some of the most exquisite specimens of stone images of various Buddhistic and Hindu gods and goddesses of the Tantric type, which should have a place in the sculpture-gallery of the nation, as embodying probably the ideals of an yet unstudied School of Hindu Art. We have also inscribed stone-pillars and monuments which reveal altogether unknown facts of the political, economic, and commercial history of Eastern India in mediæval times (8th—13th cent). To quote Mr. Akṣaya Kumâr Maitra, the guide and philosopher of the Varendra school of historical research: "These and similar inscriptions show at a glance of what stuff were made the people of old Bengal, who at one time extended their empire from shore to shore, between the Himalayas on the North and the Vindhya on the South, and what constituted the high education of the people of that age." Further, "although the Pâla kings were Buddhists, their hereditary ministers were all Brahmans. * * * Bhatta Gurava, the builder of this monument, was not only a pious Brahman, but was also an efficient minister of state, a valiant warrior, and a poet who used to be looked upon by his contemporaries as a Vâlmīki of the *Kalikâla*."

The most important stone pillars brought to prominent notice by this school of historians are (1) the inscribed *Garuḍastambha* pillar (in Dinâjpur), (2) the inscribed pillar of the Kâmboja king—a carved pillar of black basalt (in Dinâjpur), (3) the pillar of the Kaivarta leader—a stone monolith "which may be looked upon as a finger-post to indicate the decline and fall" of the Pâla Empire.

Stone-images of Viṣṇu, Durgâ, Sun-god, Bodhisattva, etc., found by the Varendra Research Society, as well as other materials in their possession enable Mr. Maitra to make the following remarks with regard to what may be proved to be the site of the capital of an old prosperous empire in the

[1] See the full report of the Malda Conference (1911) published in Bengali (1913) by the *Sâhitya Pariṣat* of Rangpur.

modern district of Malda, lying north to south on the east of the river Mahânanda: "It was indeed a city of palaces,[1] a city of gardens, and a city of fine tanks. * * * These suburban areas (including modern Pandua, Kaligrâma,[2] and other modern villages) enjoyed for a long time a great reputation as an important centre of the old weaving industry of Bengal. * * * Towards the south of the great city, there was another suburb, modern Mâdhâipur, still remembered as one of the traditional centres of Sanskrit education in the Empire of Gauḍa under the Hindus, before Nadia asserted its influence. * * * Old Malda was the port of the city connected with the Far East as well as with the historic markets of the western world."

[1] See *Stones of Vârendra*—in the *Modern Review*, June, August and September 1912.

[2] An important Tantric image of the goddess, popularly called Bhairavi, in the vicinity of Kaligrâma, has been brought to the notice of the literary world by Mr. Haridâsa Pâlit, of the District Council of National Education, Malda, and described with illustration in the Bengali monthly, the *Grihastha*, Calcutta.

CHAPTER V.

THE DATA OF ANCIENT INDIAN BOTANY.

SECTION I.

Sukraniti an a source of Botanical Information.

In *Sukraniti* references.to plants and plant-life fall into three classes :

1. The *Nitisâstra* being the architectonic or dominant science, whatever has any influence on human and social life must be discussed in it. Treatment of botanical topics thus has a very natural place in *Sukraniti.* In Hindu literature there is the tradition of Varâhamihira, the scientist of the 6th century A.D., having treated of more than a thousand phenomena of Nature as affecting the well-being of humanity in his celebrated treatise, *Brihat Samhitâ.*

2. The flora of a locality as well as the Botanical ideas obtaining in any epoch cannot but leave their mark on the literary activities of a people. The casual references of authors to vegetation, the features or habits of plants, and their uses in social life are some of the internal evidences which may be interpreted as telling the story of the author's range of experiences. Like the Data of ancient Indian Mineralogy and Geography, the Data of ancient Indian Botany that may be culled from a study of the flora in Sukranîti would thus furnish important clues to the home and surroundings as well as the epoch in which the authors of the Sukra cycle flourished. For in the first place, types of flora vary from province to province, and secondly, the knowledge about plant-life changes from epoch to epoch. The Botanical references in Sukranîti, therefore, must carry with them the 'spirit' of both Space and Time.

3. The authors of the Sukra cycle have not treated of plants *as plants,* but as substances having a direct or indirect bearing on the social, economic and political topics that concern them mainly. The treatment of plants in *Sukranîti* is, therefore, not at all what should be expected in Botany as an *abstract science,* but is purely *utilitarian* or economic. The Economic Botany of Sukrâchâryya, again, eschews the medical or Ayurvedic, and industrial or artistic branches, but is treated of only in the following aspects : (1) Agriculture, (2) Horticulture and (3) Forestry.

SECTION 2.

Identification of the Sukra Flora.

The trees, plants, shrubs, creepers, &c., mentioned in Sukranîti are being shown in three schedules.[1] The first schedule contains the plants grouped together by the authors of the Sukra cycle under the common name of *Phalinah* or fruit-bearing. The second schedule contains the plants grouped

[1] See the lists in Meyen's *Botanical Geography* (Ray Society, London, 1846), pp. 290-395.

together in the treatise under the common name of ***Kantakinah*** (thorny) and ***Âraṇyaka*** (growing in forests).

The classification is not at all scientific according to the principles of modern Botany, nor does it indicate any cleverness from the ordinary standpoint of the layman. For even as yielding edible fruits some of the plants mentioned in the second list might be well-placed in the first.

The third schedule contains the trees, plants, or shrubs to which only casual references have been made.

(*a*) *The Phalinah or Fruit-bearing Trees.*[1]

It is to be noted that the term fruit-bearing has not been used in the strict Botanical sense of Phanerogams, which, being flowering plants, are necessarily also fruit-bearing. The Sukra authors mean simply that these trees grow fruits either in abundance or such as are appreciated by men as edibles or articles of commerce.

Sanskrit Name.	English Name.	Botanical Name.	Habitat.
1. Udumvara ...		*Ficus glomerata* ...	Sub-himalayan tract and outer valleys, in ravines, on the banks of rivers and in damp places, Ajmere-Merwara, Aboo, Behar, Chutia Nagpur, Bengal plains, Khasi Hills, Chittagong, Lower Burma, Irrawadi valley, Western Peninsula, Central Provinces.
2. Aśwattha	Holy fig-tree (Peepul).	*Ficus religiosa* ...	Indigenous in the Sub-himalyan tract. Cultivated throughout India. Rare in the arid regions of N. W. India. Common on and destructive to buildings in Bengal. Sacred to Hindus and Buddhists.
3. Vata	Banyan	*Ficus bengalensis*	Commonly planted by the Hindus throughout India as far north as Peshawar and in the outer Himalaya as high as 4,000 feet.
4. Chinchâ	Tamarind	*Tamarindus indica*	Cultivated throughout India and Burma. Self-sown in waste and forest lands. The fruit does not ripen west of Amballa.
5. Chandana	Sandal	*Santalum album* ...	Indigenous in W. Peninsula. Grown in gardens north as far as Saharanpur.
6. Jâmbhâla	Lime—acid and sweet, citron, lemon.	*Citrus medica* ...	Kumaon, C. P., Sikkim, Garo Hills, Satpura Hills, Western Ghats, Chittagong, Khasi Hills.

[1] See Botanical Volume of the *Bombay Gazetteer* (1886), *Indian Trees* by Brandis, *Indigenous Drugs of India* by Kauny Lall Dey and *Dictionary of Economic Products* by Watt.

Sanskrit name.	English name.	Botanical name.	Habitat.
7. Kadamba ...		*Nauclea cadamba* ...	Terai and outer hills of Sikkim to 3,000 feet, evergreen forests of North Kanara, Northern Circars, Cuddapah and Karnul, Eastern slopes of the Pegu Yoma. Commonly planted.
8. Aśoka		*Jonesia asoka* ...	Khasi Hills, Arakan, Tenasserim, Western Peninsula, Northern Circars, and in evergreen forests of the Kankan and Kanara. Frequently planted, chiefly near temples in India and Burma.
9. Vakula	...	*Mimusops elengi* ...	Western Peninsula, southwards from Kandala Ghat on the west and Northern Circars on the east. Commonly planted, north as far as Lahore.
10. Vilwa	Bael tree	*Ægle marmelos* ...	Wild in the Sub-himalayan tracts and outer hills from the Jhelum eastwards, also in S. India and Burma. Cultivated throughout India on account of its fruit.
11. Amrita	Pear tree (Nâspâti in Hindi).	*Pyrus communis*	Largely cultivated in N. W. Himalaya.
12. Kapitthaka (Kât bel in Hindi).	Wood-apple ...	*Feronia elephantum*	Generally cultivated in both peninsulas. Indigenous in S. India and Ceylon. Bark used as a cosmetic.
13. Râjadana		*Mimusops hexandra*	Banda District, sandstone of Pachmarhi and adjoining hill ranges, Chanda District, Gujrat, Khandesh, Deccan, Srihari Kota.
14. Âmra ...	Mango	*Mangifera Indica*...	Indigenous in Burma, Sikkim, Assam, Khasi Hills, Satpuras, W. Ghats. Cultivated all over India and Burma, excepting the northern part of the Punjab.
15. Punnâga		*Calophyllum inophyllum.*	On the west coast from Bombay, on the east coast from Orissa southwards. Often cultivated, Saline tracts, Minbu District, Upper Burma.
16. Kâşthâmra ...		*Myrica sapida* ...	Outer Himalaya from the Ravi eastwards.

SANSKRIT NAME.	ENGLISH NAME.	BOTANICAL NAME.	HABITAT.
17. Tuda	Mulberry	(1) *Morus alba* ...	(1) Punjab plains, Kashmir, N. W. Himalaya.
		(2) *Morus indica* ...	(2) Wild in the Sub-himalayan tract in dry forest from the Sutlej eastward. Extensively cultivated to feed the seedworm in Bengal and Burma.
18. Champaka		*Michelia champaka*,	Wild on the Western Ghats in the southern portion, in Sikkim (up to 3,000 feet) and in Lower Burma. Cultivated in the moister parts of India and Burma, shady valleys in Singhbhum.
19. Nîpa		Variety of *Jonesia asoka*.	
20. Koka	Wild date tree	*Phœnix sylvestris*	Indigenous and gregarious in many parts of India. Planted largely. Mats and baskets made of leaves. Sugary juice extracted in the cold season.
21. Âmra		*Spondias mangifera*.	Sub-himalayan tract and outer valleys to 3,000 feet from the Chenab eastwards. Salt range in the Punjab, deciduous forests of Burma and the Western Peninsula.
22. Sarala	... Pine	*Pinus longifolia* ...	Sub-himalayan tract and outer Himalaya, abundant as far east as Nepal ; not in the inner arid valleys. Further eastward less common, in Sikkim usually on dry southern slopes. It is supposed that the rainfall in the Sub-himalayan tract here is too heavy for this species (Gamble's *Darjeeling List* Ed. ii. 1883).
23. Dârima	Pomegranate ...	*Punica granatum*	Indigenous in Persia and Afghanistan. Cultivated. Naturalised in India from remote antiquity.
24. Akṣota	(1) Walnut (âkhrot in Hindi).	(1) *Juglans regia* ...	(1) Indigenous trans-Indus in the Kurram valley, N.-W. Himalaya, Sikkim.
	(2) Indian walnut.	(2) *Aleurites moluccana*.	(2) Indigenous probably in the Malaya Archipelago. Cultivated in most tropical and subtropical countries, and here and there naturalised,

Sanskrit name.	English name.	Botanical name.	Habitat.
25. Śiṃśupâ		*Dalbergia sissoo* ...	Sub-himalayan tract and in outer valleys from the Indus to Assam. Extending far into the plains along river banks. Planted and often selfsown throughout India.
26. Bhissata.			
27. Vadara	Jujube (kool in Bengali).	*Zizyphus jujuba* ...	Indigenous and naturalised throughout India and Burma. Grown in gardens for its fruit.
28. Nimba ...	Neem or Margoza.	*Azadirachta indica*	Wild in the dry region of the Irrawady valley. Cultivated and naturalised throughout India, rare west of the Sutlej.
29. Śimbhu.			
30. Jambîra ...	Lime	Variety of *Citrus medica.*	
31. Kṣirika		Variety of *Mimusops hexandra.*	
32. Kharjura		(1) Variety of *Phœnix sylvestris.*	
	(2) Date-palm	(2) *Phœnix dactylifera.*	(2) Cultivated and selfsown in Sind and Southern Punjab, attempts to grow it have been made in other parts of India.
33. Deva karaja ...		*Pongamia glabra* ...	Common near banks of streams and water-courses in both peninsulas, Travancore, Oudh Forests, here and there in Sub-himalayan tract, ascending to 2,000 feet.
34. Phâlgu ...	Opposite-leaved fig tree. (?)		
35. Tâpinchchha[1] (Tamâla).		Variety of *Garcinia xanthochymus.*	
36. Simbhala.			
37. Kuddâla ...	Ebony ...	*Diospyros melanxylon.*	Common in deciduous forests of C. P., Chutia Nagpur, Behar and W. Peninsula.
38. Lavalî		(1) *Phyllanthus distichas.*	(1) In gardens throughout India.
		(2) *Anona reticulata*	(2) Cultivated over a great part of India.

[1] It is to be noted that *Tâpinchchha* is a variety of *Tamâla* (Garcinia xanthochymus) included in the list of wild flora in *Sukranîti.*

Sanskrit name.	English name.	Botanical name.	Habitat.
39. Dhâtrî	...	*Woodfordia floribunda.*	Widely spread from tropical Africa, Arabia to India, ascending to 5,000 feet in the Himalaya and to both peninsulas.
40. Kramuka	Betel-nut	*Areca catechu* ...	Cultivated in the tropical and sub-tropical regions of India and Burma, in gardens and orchards on the W. coast and in N. Bengal. The seeds are an important article of trade, the spathes are used to write upon, to wrap up parcels, and as covering leaf of cheroots in Burma.
41. Mâtulungaka...	Citron	Variety of *Citrus medica.*	
42. Lakoocha		*Artocarpus lakoocha.*	Sub-himalayan tract and outer hills, from Kumaon eastwards, ascending to 4,000 feet Khasi Hills. Burma, evergreen forest of the Western Ghats from the Konkan southwards.
43. Nârikela	Cocoanut	*Cocos nucifera* ...	Cultivated throughout the tropics, chiefly in the vicinity of the sea, but also inland.
44. Rambhâ	... Plantains	*Musa sapientum*...	Extensively cultivated throughout India, nearer coast tracts than inland.

The list of fruit-bearing trees in the Sukra Flora contains 44 plants. Of these four have not been identified, *viz.*, (1) Bhissata, (2) Śimbhu, (3) Simbhala and (4) Phâlgu. The remaining 40 plants belong to 35 species, as four species have been mentioned in varieties comprising nine plants, *e.g.*, (1) *Citrus medica* as Jâmbhâla, Jambîra, and Mâtulungaka, (2) *Jonesia asoka* as Asoka and Nîpa, (3) *Mimusops hexandra* as Râjadana and Kṣirika, (4) *Phœnix sylvestris* as Koka and Kharjura.

These 35 species are grouped under the following 19 Natural Orders :—

I. Rutaceæ ...
(1) Citrus medica.
(2) Ægle marmelos.
(3) Feronia elephantum.

II. Urticaceæ
(1) Ficus glomerata.
(2) Ficus religiosa.
(3) Ficus bengalensis.
(4) Morus alba or Indica.
(5) Artocarpus lakoochu.

III Leguminosæ ...
(1) Tamarindus indica.
(2) Jonesia asoka.
(3) Dalbergia sissoo.
(4) Pongamia glabra.

IV.	Santalaceæ	...	Santalum album.
V.	Rubiaceæ	...	Nauclea cadamba.
VI.	Sapotaceæ	(1)	Mimusops elengi.
		(2)	Mimusops hexandra.
VII.	Rosaceæ	...	Pyrus communis.
VIII.	Anacardiaceæ	(1)	Mangifera indica.
		(2)	Spondias mangifera.
IX.	Magnoliaceæ	...	Michelia champaka.
X.	Palmaceæ	(1)	Phœnix sylvestris.
		(2)	Areca catechu.
		(3)	Cocos nucifera.
XI.	Coniferæ ...	...	Pinus longifolia.
XII.	Juglandaceæ ...		Juglans regia.
XIII.	Meliaceæ ...	...	Azadirachta indica.
XIV.	Euphorbiaceæ...		Phyllanthus distichas.
XV.	Musaceæ	...	Musa sapientum.
XVI.	Guttiferæ	(1)	Calophyllum inophyllum.
		(2)	Garcinia xanthochymus.
XVII.	Myricaceæ		Myrica sapida.
XVIII.	Ebenaceæ	...	Diospyros melanxylon.
XIX.	Lythraceæ	(1)	Woodfordia floribunda.
		(2)	Punica granatum.

(*b*) *The Âraṇyaka Trees.*

The following list contains the names of trees which, according to Sukrâchâryya should be planted in forests :—

SANSKRIT NAME.	ENGLISH NAME.	BOTANICAL NAME.	HABITAT.
1. Khadira	Catechu	*Acacia catechu*	Sub-himalayan tract from the Indus eastwards, generally gregarious on islands and on the banks of rivers at their entrance into the plains. Common on the Aravalli Hills and in the W. Peninsula, as well as Burma, Central Provinces, Chutia Nagpur, Behar.
2. Asmanta	Oxalis, (?) probably Indian hemp.	*Crotalaria burhia*	Common in the plains of Sind, Punjab, W. Rajputana and Gujarat.
3. Sâka	Teak	*Tectona grandis* ...	Indigenous in both peninsulas. In W. India attains its northern limit in W. Aravallis at 24°42′ N. Lat. In C. India its northernmost point is Jhansi. Cultivated in Bengal and Assam and in N. India as far as Dehra Dun.

SANSKRIT NAME.	ENGLISH NAME.	BOTANICAL NAME.	HABITAT.
4. Agnimantha ..		*Premna integrifolia.*	West Peninsula, Bengal, Burma.
5. Syaunáka		*Oroxylum indicum*	Sub-himalayan tract from the Jumna eastwards. Rare west of the Jumna.
6. Vabbula		*Acacia arabica*	Indigenous in Sind and Northern Deccan, including Berar and Khandesh. Cultivated and naturalised throughout India, except in the most humid regions. The pods are excellent cattle-fodder. Gum exudes largely from wounds in the bark.
7. Tamâla		*Garcinia xanthochymus or Cinnamonum tamâla.*	Sikkim, Assam, Khasi, Chittagong, W. Peninsula, Circars, W. Ghats, N. Kanara.
8. Sâla		*Shorea robusta* ...	Two irregular, but fairly defined belts: (1) Sub-himalayan belt from Kangra valley to Darrang (Assam). Further to N. W. the cold is too severe, further east, the climate is too moist. (2) Central Indian belt extends from Coromandel coast west to Pachmarhi sandstone hills and south to Godavari river.
9. Kutaja		*Holarrhena antidysenterica.*	Sub-himalayan tract, from the Chenab eastwards, common in sâl forest. Aravalli Hills, Behar, C. P. western Peninsula, Bengal. One of the trees to be employed in reclaiming waste lands.
10. Dhava		*Anogeissus latifolia*	Sub-himalayan tract from the Ravi to Nepal, C. I., Western Peninsula, Chutia Nagpur, Behar, Orissa. Not in Assam, Eastern Bengal nor Burma.
11. Arjuna		*Terminalia arjuna*	Common on the banks of rivers, streams and dry water courses in C. I. and S. Behar, in the Peninsula and Ceylon, Jammu, Chutia Nagpur. Here and there in Sub-himalayan tract. Not in east and Central Bengal, nor in Burma.
12. Palâsa		*Butea frondosa* ...	Common throughout India and Burma, often gregarious. In the N. W. Himalaya. In Travancore not common.

SANSKRIT NAME.	ENGLISH NAME.	BOTANICAL NAME.	HABITAT.
13. Saptaparṇa ...		*Alstonia scholaris*	Sub-himalayan tract, ascending to 3,000 feet from the Jumna eastwards. Western Peninsula and Burma, mostly in deciduous forests, Bengal, Assam, Andamans.
14. Śamî		*Acacia suma*	W. Peninsula, both on the west as well as east side extending north to Pertabgarh, in S. Râjputana, Lower Bengal.
15. Tunna		*Cedrela toona*	Sub-himalayan tract from the Indus eastwards. Evergreen forests of the W. Ghats and other hills of the W. Peninsula, Khasi Hills, Manipur, Upper and Lower Burma. Cultivated extensively.
16. Devadâru ...	Himalayan cedar.	*Cedrus deodara* ...	Afghanistan, Chittral, Kurram, N. W. Himalaya. On two feeders of Alakananda. Cultivated in Kumaon and Nepal.
17. Vikankata ...		*Flacourtia sapida*	Sub-himalayan tract from the Punjab eastwards, Rajputana, Behar, Central India, the Deccan, and the Peninsula, mostly in dry open places and on rocky hills, Manipur.
18. Karamaṇḍa ...		*Carissa carandas*	Cultivated for its fruit in most parts of India.
19. Ingudî		*Balanites roxburghii.*	Chiefly in the drier parts of India and Burma, as far north as Delhi, common in the open country, particularly on stiff clay soil.
20. Bhûrja		*Betula bhojapatra*	Kurram valley, 10—11,000 feet, in Himalaya, 10—14,000 feet, in the Punjab as low as 7,800 feet, also in the inner arid region. Often gregarious at the upper limit of tree vegetation. The outer bark is used as a paper for writing and packing, for umbrella covers and for the roofing of houses.

Sanskrit name.	English name.	Botanical name.	Habitat.
21. Viṣamuṣthi ..		*Strychnos nux-vomica.*	Gorakhpur forests. Near Pundua, Orissa, W. Peninsula, Burma. The seeds contain strychnine, an extremely bitter and most poisonous alkaloid.
22 Karîraka		*Capparis aphylla*	Arid and dry regions of W. Peninsula, from the Punjab and Sind to Tuticorin, waste lands of the Doab.
23. Sallaki		*Boswellia serrata*	Sub-himalayan tract from the Sutlej eastwards and throughout the drier parts of the Western Peninsula. Always in deciduous forests and often gregarious, forming open forests, C. India, Behar, Chutia Nagpur.
24. Kâśmarî		*Gmelina arborea*	Sub-himalayan tract from the Chenab eastwards. Aravalli Hills, C. I., Singhbhum, Western Peninsula, Burma, Assam, Central Bengal, South Lusai Hills, Chittagong.
25. Pâthâ		*Stephania hernandifolia.*	Sub-himalayan tract from Nepal eastwards, Assam, Khasi Hills, Bengal, Burma, W. Ghats and Coast, Ceylon.
26. Tinduka		*Diospyros embryopteris.*	Sub-himalayan tract from the Jumna to the Tista, chiefly in ravines and moist shady places. C. I., W. Peninsula, common in Northern Circars, Bengal. The pulp of the unripe fruit is used as gum and in the place of tar for paving the seams of boat.
27. Vîjasâraka ..		Variety of *Citrus medica.*	
28. Harîtakî		*Terminalia chebula*	Sub-himalayan tract from the Sutlej eastwards. Common in the deciduous forests. The dry fruit is one of the best tanning materials. (See Brandis' *Indian Trees*, p. 308, Edition of 1906).
29. Bhallâta	Marking nut	*Semecarpus anacardium.*	Sub-himalayan tract from the Bias eastwards. Assam, Khasi Hills, Chittagong, C. I., W. Peninsula, Behar, Chutia Nagpur, Upper Burma.

SANSKRIT NAME.	ENGLISH NAME.	BOTANICAL NAME.	HABITAT.
30. Sampâka.			
31. Arka		*Calotropis gigantea.*	Common in the plains of Northern India and in the Peninsula, Jabalpur, Sundariban, Singhbhum, often gregarious. Fibre silky, made into rope, paper and cloth.
32. Puṣkara.			
33. Arimeda		*Acacia farnesiana*	Throughout India and Burma.
34. Pîtadru	Variety of pine (Deodar).		
35. Śâlmali	The cotton tree.	*Bombax malabaricum.*	Sub-himalayan tract from the Indus eastwards. Common in both peninsulas and often cultivated.
36. Vibhîtaka		*Terminalia bellerica.*	Sub-himalayan tract from near the Indus eastwards. Common throughout India and Burma, excepting the arid region of Sind, Western Rajputana and the Southern Punjab. Fruit used for dyeing and tanning.
37. Naravela.			
38. Madhuka		*Bassia latifolia*	Planted in most parts of India, propagating itself by selfsown seed. Indigenous in the Sub-himalayan tract from the Ravi to the Great Gandak, in the Satpura range, and the Peninsula.

The list of *Âraṇyaka* Flora in *Sukranîti* contains 38 plants. Of these, three have not been identified: (1) Sampâka, (2) Puṣkara and (3) Naravela. The remaining 35 plants belong to 34 species,[1] as one species has been mentioned in two varieties, *e.g.*, the *Pinus deodara* as Devadâru and Pîtadru.

These 34 species are grouped under the following 23 Natural Orders:

I. Leguminosæ ...	(1) Acacia catechu.
	(2) Crotalaria burhia.
	(3) Butea frondosa.
	(4) Acacia arabica.
	(5) Acacia suma.
	(6) Acacia farnesiana.
II. Verbenaceæ	(1) Tectona grandis.
	(2) Premna integrifolia.
	(3) Gmelina arborea.

[1] It is to be noted that *Vijasâraka* mentioned here is a variety of *Citrus medica* included in the Fruit-bearing list.

III. Bignoniaceæ		Oroxylum indicum.
IV. Guttiferæ ...		Garcinia xanthochymus.
V. Dipterocarpaceæ		Shorea robusta.
VI. Apocynaceæ	(1)	Holarrhena antidysenterica.
	(2)	Carissa carandas.
	(3)	Alstonia scholaris.
VII. Combretaceæ	(1)	Anogeissus latifolia.
	(2)	Terminalia arjuna.
	(3)	Terminalia chebula.
	(4)	Terminalia bellerica.
VIII. Meliaceæ		Cedrela toona.
IX. Coniferæ ...		Cedrus Deodara.
X. Bixaceæ ...		Flacourtia sapida.
XI. Simarubaceæ		Balanites roxburghii.
XII. Betulaceæ		Betula bhojapatra.
XIII. Loganiaceæ		Strychnos nux vomica.
XIV. Capparidaceæ		Capparis aphylla.
XV. Burseraceæ ...		Boswellia serrata.
XVI. Menispermaceæ		Stephania hernandifolia.
XVII. Ebenaceæ		Diospyros embryopteris.
XVIII. Rutaceæ ...		Citrus medica.
XIX. Anacardiaceæ		Semecarpus anacardium.
XX. Asclepiadaceæ		Calotropis gigantea.
XXI. Malvaceæ		Bombax malabaricum.
XXII. Sapotaceæ		Bassia latifolia.

(c) *Other Plants.*[1]

The following is the list of plants to which references have been made in *Sukraniti* either as illustrations or as economic products of daily domestic use, etc.:

	SANSKRIT NAME.	ENGLISH NAME.	BOTANICAL NAME.	HABITAT.
1.	Utpala, Kamala.	Lotus	*Nelumbium speciosum.*	Large aquatic herb found all over India and extending as far north as Kashmir.
2.	Sarṣapa	Mustard	*Brassica campestris.*	Throughout India.
3.	Veṇu	Bamboo	*Dendrocalamus strictus.*	Widely spread and very common throughout India and Burma.
4.	Vrihi	Rice	*Oryza sativa.*	Cultivated throughout India. Chief wild habitat from Madras and Orissa to Bengal, Chittagong, Assam. Extends to Nilgiri Hills, U. P., and even to Punjab.

[1] See *Food-Grains of India* by A. H. Church (Chapman & Hall, London, 1886), *The Indian Empire* in the Imperial Gazetteer of India Series, Vol. III, Economic, Chapter II (1907). Watt's *Dictionary of Economic Products of India*, Vols. V, VI (Parts I and II).

SANSKRIT NAME.	ENGLISH NAME.	BOTANICAL NAME.	HABITAT.
5. Ikṣu	Sugarcane	*Saccharum officinarum.*	U. P., Bengal, Punjab. Cultivated throughout sub-tropical and tropical Asia and the islands of the Indian and Pacific oceans.
6. Tâmbûla	Betel leaf	*Piper betle*	Cultivated for the sake of its leaves in the hotter and damper regions of India and Ceylon (Madras, C. P., Bengal, U. P., Bombay).
7. Kuluttha	Horse gram ...	*Dolichos biflorus* or *uniflorus.*	Wild in the Himalaya to Ceylon and Burma, ascending to 3,000 feet in Sikkim. Not infrequently cultivated.
8. Mâṣa	Black gram ...	*Phaseolus radiatus*	Both wild and cultivated throughout the plains.
9. Mudga ...	Green gram ...	*Phaseolus mungo*	Both wild and cultivated throughout the plains, ascending to 6,000 feet in the outer ranges of N. W. Himalaya.
10. Yava	Barley	*Hordeum vulgare*	Throughout India.
11. Tila ...	Sesamum	*Sesamum indicum*	Cultivated throughout the tropical regions of the globe. In India a crop of the warm temperate or sub-tropical tracts.
12. Niṣpâpa		*Dolichos sinensis* or *lablab.*	Wild and cultivated throughout India.
13. Makuṣtha		*Phaseolus aconitifolius.*	Throughout India from Himalaya to Ceylon and extending from the tropical region up to 4,000 feet in the N. W.
14. Chaṇaka	Gram ...	*Cicer arietinum* ...	Extensively cultivated throughout India, especially in the Northern Provinces.
15. Masûra	Lentil ...	*Ervum lens* or *Lens esculenta.*	Winter crop all over India.
16. Snuhi		*Euphorbia neriifolia*	Wild on rocky ground in C. I., and extensively cultivated in the neighbourhood of villages in Bengal and elsewhere.
17. Rasona ...	Garlic ...	*Allium sativum* ...	Cultivated all over India.
18. Nilî ...	Indigo ...	*Indigofera tinctoria.*	Cultivated as an annual or as a biennial or triennial.
19. Tula (Bengali name for Kârpâsa),	Cotton ...	*Gossypium herbaceum.*	Egypt, Asia Minor, Northern Africa and Southern Europe. Cultivated at least in N. W. India even as early as Alexander. (*Watt's Dictionary.*)

SANSKRIT NAME.	ENGLISH NAME.	BOTANICAL NAME.	HABITA .
20. Godhuma	Wheat. ...	*Triticum vulgare* or *sativum*.	Generally, in those parts of India, where rice does not thrive; but rarely it is cultivated anywhere south of the Deccan.
21. Harimatha ...	Peas	*Pisum sativum* ...	Perhaps existed in Northern India before the arrival of E. Aryans. Universal.
22. Śwetasarśapa,	White mustard or Rye.	*Brassica alba*	Supposed to be a native of more southern portion of Europe and Western Asia. By no means a common plant.
23. Gunja, Rati, Krisṇala.		*Abrus precatorius*	All along the Himalaya ascending to altitude 3,000 feet and spreading through the plains of India to Ceylon and Siam.
24. Gânjâ	Indian hemp...	*Cannabis sativa* ...	Wild on the Western Himalaya and Kashmir and acclimatised on the plains of India generally.

The list consisting mainly of pulses and cereals contains 24 plants belonging to 24 species. The absence of millets and some other cereals is to be noted, but does not prove anything; for the presence of barley in the list indicates the conditions necessary for the growth of all these. The 24 species fall under the following nine Natural Orders :—

I. Leguminosæ ...	(1) Dolichos biflorus.
	(2) Phaseolus radiatus.
	(3) Phaseolus mungo.
	(4) Dolichos lablab.
	(5) Phaseolus acontifolius.
	(6) Cicer arietinum.
	(7) Lens esculenta.
	(8) Indigofera tinctoria.
	(9) Abrus precatorius.
	(10) Pisum sativum.
II. Gramineæ	(1) Hordeum vulgare.
	(2) Dendrocalamus strictus.
	(3) Oryza sativa.
	(4) Saccharum officinarum.
	(5) Triticum sativum or vulgare.
III. Cruciferæ	(1) Brassica campestris.
	(2) Brassica alba.
IV. Nymphaceæ ...	... Nelumbium speciosum.
V. Euphorbiaceæ...	... Euphorbia neriifolia.
VI. Liliaceæ ...	... Allium sativum.
VII. Piperaceæ	Pipor betle.
VIII. Pedalineæ	Sesamum indicum.
IX. Urticaceæ	Cannabis sativa.

SECTION 3.

The Locale of Sukranīti.

1. '*Botanical Statistics' applied to Sukranīti.*

The Sukra Flora consists of a little above 100 plants, of which seven have not been identified. Taking into consideration the varieties, the total number of species in *Sukranīti* is 93 under 40 Natural Orders. Only three of these orders belong to the Monocotyledon class, *e.g.*, Liliaceæ, Palmæ and Gramineæ.

In numerical importance the dominant Orders of Sukra Flora are given below :—

1.	Leguminosæ	18 species.	9.	Palmaceæ ...	3 species.
2.	Urticaceæ ...	5 "	10.	Sapotaceæ	3 "
3.	Rutaceæ	4 "	11.	Euphorbiaceæ	2 "
4.	Gramineæ ...	4 "	12.	Coniferæ ...	2 "
5.	Combretaceæ	4 "	13.	Lythraceæ	2 "
6.	Verbenaceæ	3 "	14.	Guttiferæ	2 "
7.	Apocynaceæ	3 "	15.	Ebenaceæ ...	2 "
8.	Anacardiaceæ ...	3 "			

The habitats or 'station' of the plants given in the tables in the preceding section indicate a wide range both horizontally and vertically. The 'regions' and 'zones' of the Sukra Flora are thus varied like those of the whole of Indian vegetation. Himalayan, Sub-himalayan, alluvial, riparian, deciduous, evergreen, arid, rocky, and littoral (seacoast), in fact, all the descriptions of Indian Flora have their specimens in Sukranīti. Their vertical distribution also ranges from sea-level to about 3,000 feet high and more. The Sukra Flora thus tells the story of the diverse meteorological, physiographical and geological features of the Indian continent, and may be regarded as more or less epitomical of Flora Indica.

Many of these plants are cosmopolites, distributed, whether as indigenous or naturalised, throughout the country. Except the Pinus longifolia (sarala) which is characteristic of Himalayan Flora, the Santalum album which is characteristic of South India, and the Palmæ of the hot and humid regions, the Sukra Flora does not seem to contain any characteristically local or provincial specimens. If we add to these the fact that as articles of commerce for the necessaries, medicines, arts, industries, comforts and luxuries of life most Indian plants have been known in all parts of India since very early times,[1] we can realise the difficulty of characterising the Sukra Flora as belonging to a particular area on the strength of the 'statistics' and 'physiognomics' of plants, and thus of ascertaining the 'locale' of *Sukranīti* from a study of the geography of its flora.

The small percentage of Monocotyledons in proportion to the Dicotyledons indicates lower latitude and absence of great cold. This is according to the

[1] The *Charaka Samhita*, a medicinal work of the Pre-Buddhistic times, written certainly in the Punjab, mentions Santalum album. Roxburgh in *Flora Indica* (1874) notes the luxuriant growth of the plant in Calcutta Botanical Gardens (p. 148).

reckonings of Humboldt[1] who determined after laborious processes that "in the torrid zone the monocotyledons are as 1 : 6 to the Dicotyledons, while in the temperate zone the proportion is 1 : 4, and in the arctic 1 : 3." This delimitation of area, however, is too wide, as it gives only one general term 'equatorial' for the distribution of the Sukra Flora.

From the statistics of the species and Natural Orders, however, we can generalise, though still within wide limits, as to the Geography of the Sukra Flora more satisfactorily than above. For most of the species in the Sukra Flora may be allotted to the sub-tropical zone, the botanical characteristics of which are given below :[2] "In the sub-tropical zone the vegetation is green throughout all the year like the forests of the damp regions of the torrid zone. From the great heat of the sun palms as well as bananas grow here in the plains. * * * The date-palm belongs to the whole western part of the sub-tropical zone of the old world. * * * In summer* there is a tropical heat which ripens almost all the fruits of the equatorial zone, while in winter the temperature is so low that often old trees of the well-known noble tropical fruits perish. During the summer which is here at the rainy season there are cultivated rice, indigo, cotton tree, &c.; of leguminosæ, species of phaseolus and dolichos ; gourds, sesamum, &c.

But the appearance of the inhabited districts of this country is totally different in winter when the cereals of the north are cultivated such as wheat, barley, oats, millet, and also beans, mustards, &c. But the vegetation of the uncultivated places as well as of the cultivated soil exhibits these different characters at the different seasons; that is, in summer it resembles the vegetation of the warmer zones. In winter, on the contrary, only old well-known genera belonging to the colder part of the temperate zone appear. * * * The chief plants which in summer adorn the district round Delhi with a more southern character, are Dalbergia sissoo, Acacia serissa, arabica, farnesiana, Cedrela toona and various species of Melia, Ficus, Morus, Gmelina, Phœnix, &c."

This diversity of vegetation according to seasons of the year would well explain the wide differences in the habitation of the plants in Sukranīti we have referred to at the beginning. The following general description of the physiognomy and topography of the countries of the sub-tropical zone, also, fits in very well with the varied physiography suggested by the Sukra Flora :—" In all the plants we have named we perceive a receding from the equator ; there is no longer a trace of the excess of tropical forms ; but so beautiful a country, the climate of which unites the advantages of the torrid and temperate zones, will in the possession of an active nation, soon become the rendezvous of all the cultivated plants of the various zones, and even now there is grown there a variety of the

[1] Meyon's *Botanical Geography* (1846), pp. 278-79.

[2] Meyen's *Botanical Geography* (1846). pp. 177 etc. The country round Delhi and from Delhi to Serampore on the Hooghly has been taken as typical of the sub-tropical zone.

beautiful fruits of the torrid and temperate zones, such as hardly any country can boast of."

Thus gradually narrowing the boundaries we come to the conclusion that the Flora of the sub-tropical zone may well cover the whole of Sukra Flora. We have to note also that the chief characteristic of this zone, as of the Sukra Flora, is the double aspect according as the summer or winter vegetation is most fully displayed.

In order to find out more closely the locale of this vegetation in India it now remains to apply or interpret the above hypothetical generalisation about Sukra Flora according to the facts and conditions of Indian Phyto-geography. We therefore proceed to enquire into the regions and sub-regions of India, botanically considered, according to (1) ecological evidences and (2) literary evidences. We shall then be in a position to demonstrate (1) how far the sub-tropical theory is tenable and (2) which portions of this zone are indicated.

For the ecological evidences we should have to take a broad survey of Indian Botanical Geography and study the chief provinces or divisions into which the country may be divided according to the predominent types of vegetation brought on by the conditions of soil, physical features, environment and climate, &c. In the second place, the Sukra Flora would have to be allocated in one or other of these botanical provinces. The hypothesis about the sub-tropical character of the Sukra Flora would thus be incidentally verified.

For literary evidences we require a historic survey of Indian literature. The objects are :—(1) to trace the influence of topographical and botanical conditions on the literary activities of ancient and mediäeval scholars, *e.g.*, to detect any clues as to the local character of the botanical references by Indian authors, and (2) to compare, contrast or connect the Sukra Flora, if possible, with the important Floras celebrated in Indian literary history, *e.g.*, Vedic, Pāṇinian, Charakan, Buddhistic, Kâlidâsic, Amarasimhan, Varâhamihiran, Tantric, Paurâṇic, and so on, as regards geographical affinity or otherwise.

2. *Ecological Evidences.*

In the following summary of the characteristics of Indian Botanical Geography we are giving a synopsis of the classical remarks of Dr. Hooker and Dr. Thomson in the celebrated *Introductory Essay* to their monumental *Flora Indica.* " From the position of India, its climate (and hence its vegetation) is more generally tropical, than the latitude under which so much of it is included would alone indicate. The mountains, however, when above 4—5,000 feet everywhere present more or less of a temperate vegetation which becomes wholly temperate at greater elevations and which passes into an alpine flora over a large extent of still loftier mountain country."

The tropical character is thus the most general feature of Indian vegetation. " The general physiognomy of the greater part of the Indian Flora probably approximates more to that of tropical Africa than to any other part of the globe,

accompanying in both cases immense alluvial plains, bounded by deserts at certain points and traversed by mountian chains of moderate elevation."

The vegetation, however, does not present a dead uniformity, but is richly diversified in aspect. Thus

(1) the impenetrable green jungles of Eastern Bengal, and the west coast of the Madras Peninsula contrast strongly with the drier parts of the inter-tropical zone, and still more so with the loosely-timbered districts of Central India and of the base of the Western Himalaya.

(2) The tropical forests may be divided into (*a*) those which inhabit perennially humid districts and (*b*) those which are confined to regions presenting contrasted seasons of summer rain and winter drought.

(3) The third circumstance which contributes to diversity in Indian Flora is the peculiar protean climate of the extra-tropical regions. These unite within themselves by a change of seasons the conditions of both tropical and more or less temperate floras. This holds true not only with regard to forest vegetation, but also with regard to annuals and perennially rooted plants with annual stems. The intrusion of tropical floras upon extra-tropical regions and loftier mountain valleys in summer, and the appearance of annual plants of the north temperate zone in the extra-tropical regions during the cold months are causes which greatly modify the vegetation of India in general aspects and character.

Now, taking the more fundamental climatological forces into view, the whole of India may be regarded as constituting only one Botanical area, sub-divided for ordinary (and less scientific) purposes into tropical and sub-tropical. This is practically what Hooker and Thomson did in the *Introductory Essay* in 1855; in which, to quote from Brandis' *Indian Trees*, [1] "four primary divisions were recognised, *viz.* i. Hindustan including the Western Peninsula from the base of the Himalaya to Cape Comorin; ii. The Himalaya; iii. Eastern India or India east of the mouth of the Ganges; and iv. Afghanistan and Baluchistan."

The same thing has been done, though under slightly different names, by Hooker in the chapter on Indian Botany in Vol. I. of the *Indian Empire* of the Imperial Gazetteer Series (1906). To quote Brandis, again, "In this admirable paper Hooker divides British India primarily into three Botanical areas, a Himalayan, an eastern and a western, the two last-named being roughly separated by a line drawn meridionally from the Himalaya to the Bay of Bengal. These areas he divides into nine provinces, *viz.*, (1) The Eastern Himalaya, (2) The Western Himalaya, (3) The Indus plain, (4) The Gangetic plain, (5) Malabar in a very broad sense, (6) The Deccan in a very extended sense, (7) Ceylon, (8) Burma and (9) Malaya Peninsula."

It is in one or other of these Botanical provinces that we have to seek the types represented by the Sukra Flora.

The chief difficulty arises from the fact that, though "each one of these is distinguished from the others by the possession of some characteristic forms

[1] Pp. XV. xvi (Edition of 1906).

of vegetation and more especially by the general aspect and constitution of its flora, it must not be assumed [1] that all the species of a botanical province are to be found nowhere outside its geographical limits. On the contrary, the characteristic vegetation of one province passes by insensible gradations into that of another, so that, owing to the absence of any sharply defined limits, their boundaries cannot be considered as more than approximative."

(*A*) *Gujrât Flora and Sukra Flora.*

If individual species or orders are considered, the Sukra Flora may be more or less wholly located within parts of almost each one of these provinces.

Thus in the list of Gujrat Trees compiled in Vol. XXV of *Gazetteer of the Bombay Presidency* (1886), we get the following specimens of the Sukra Flora :

(*a*) *Fruit Trees.*

1. Mangifera indica. 2. Bassia latifolia. 3. Tamarindus indica. 4. Zizyphus jujuba. 5. Feronia elephantum. 6. Ægle marmelos. 7. Carissa carandas. 8. Diospyros melanxylon. 9. Citrus medica. 10. Punica granatum. 11. Morus indica. 12. Anona reticulata. 13. Cocos nucifera. 14. Areca catechu. 15. Musa sapientum.

(*b*) *Flowers and Flowering Trees.*

1. Michelia champaka. 2. Bombax malabaricum.

(*c*) *Timber Trees.*

1. Tectona grandis. 2. Dalbergia sissoo. 3. Gmelina arborea. 4. Acacia arabica. 5. Anogeissus latifolia.

(*d*) *Aroma and spice-producing Trees.*

1. Santalum album. 2. Boswellia serrata.

(*e*) *Dye pigment and Tan-yielding Trees.*

1. Butea frondosa. 2. Acacia catechu. 3. Terminalia bellerica. 4. Woodfordia floribunda.

(*f*) *Other useful Trees.*

1. Holarrhena antidysenterica. 2. Dendrocalamus strictus.

(*g*) *Liquor-yielding Trees.*

1. Phœnix sylvestris.

(*h*) *Shade Trees.*

1. Terminalia arjuna. 2. Ficus glomerata. 3. Ficus religiosa. 4. Ficus bengalensis. 5. Pongamia glabra. 6. Azadirachta indica.

(*i*) *Miscellaneous Trees.*

1. Balanites roxburghii.

(*j*) *Hedge Plants.*

1. Euphorbia neriifolia.

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[1] Remarks about the Flora of the Bombay Presidency (divided into five Botanical Provinces) by Dr. W. Gray.

In the above list we have altogether 39 species, out of 93 in the Sukra Flora. As the Gujrat list does not contain the cereals, pulses and other food-grains we have to deduct at least 24 from the Sukra list for purposes of comparison. The result is that above half of Sukra Flora is represented in Gujrat, an area which, according to the Botanical divisions of Hooker, falls within two provinces, the Indus plain and Malabar.[1]

(B) Bengal (Gangetic Plain) Flora and Sukra Flora.

Exactly the same may be said with greater force about the plants of Bengal, also, which forms the humid region of the Gangetic delta and the region immediately north of it, constituting the southern sub-region of Hooker's Botanical province of the Gangetic plain. "The villages[2] are usually buried in groves of mango, figs, and bamboos, with the betel-nut, palm, palmyra, phœnix and cocoa-nut." "The indigenous flora is much more extensive than that of the upper Gangetic plain, comprising[3] all the species which grow there (except those belonging to the Egyptian or arid flora), besides many others which are not found to the north-west."

Now this inclusion of Upper Gangetic Flora within the area of Bengal means practically the inclusion of all the characteristic floras of India. For, according to the *Introductory Essay*, "If we exclude this dry country flora, which just skirts the southern part of the plain, the vegetation of the Gangetic plain presents few peculiar features; indeed a catalogue of the plants of Rohilkhand contains very few species which are not common all over India, even to the extreme south of the peninsula, in those provinces which have a similar climate. * * * We have already had occasion to direct attention to the remarkable uniformity of the vegetation over large areas of India, and as our information becomes more precise, the sameness becomes more striking."

These circumstances lead to Bengal Flora being more copious, varied and epitomic of India, comprising (1) not only the characteristic vegetation of humid regions like portions of Gujrat, but also (2) the species that are more or less uniformly distributed over the whole of India, excepting only the peculiar vegetation of arid regions. The result is that Bengal alone can supply a greater percentage of the Sukra Flora than Gujrat or other areas having more or less the climate of Bengal type.

And if following Botanical Geographers, we take Bengal proper along with the other sub-regions of the Gangetic provinces as one Botanical Region,

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[1] See Imperial Gazetteer, *Indian Empire*, Vol. I, p. 163.

[2] *Indian Empire* in the Imperial Gazetteer of India, Vol. I, 183.

[3] *Introductory Essay to Flora Indica* by Hooker and Thomson, p. 165; see also *Records of the Botanical Survey of India*, Vol. III, No. 2. "The Vegetation of the districts of Hughli, Howrah and 24-Pergunnahs" by D. Prain (1905). It is interesting to learn that, of the 80 species in the two lists of Sukra Flora, 44 are to be found in these two districts of Bengal alone. Cf. the lists of plants in the introductory section on Topography and Vegetation (pp. 140-168). As for the cereals and other plants, the whole Sukra Flora is represented in this small enough area.

the whole of the Sukra Flora including, as it does, the deciduous, evergreen, riparian, arid, littoral, humid and other species can be without the least difficulty located in this habitat, which has an extensive area, slightly diverse geological character and the characteristic round of seasons. For this Gangetic plain[1] comprises (1) an upper region including Rajputana east of the Aravalli Hills, Bundelkhand, and Malwa north of the Vindhya range and (2) a lower, including Bengal south of the Himalayas, Orissa north of the Mahanadi, the Assam, Sylhet, Cachar, and Tippera plains.

(C) South Indian Flora and Sukra Flora.

About the vegetation of Southern India we summarise below the remarks of Hooker and Thomson in the *Introductory Essay*: "From the humid character of the Malabar climate, its luxuriant vegetation might be inferred. Hamilton tells us that it resembles Bengal in verdure, but has loftier trees and more palms : the shores are skirted with cocoanuts, and the villages surrounded with groves of betel-nut, palms, &c. * * * The low valleys are richly clothed with rice-fields and the hill sides with millets and other dry crops, whilst the gorges and slopes of the loftier mountains are covered with a dense and luxuriant forest. The mass of the flora is Malayan, and identical with that of Ceylon, and many of the species are further common to the Khasia and the base of the Himalaya.* * * The whole Concan is more open than Malabar, heavy forests are rarer, many tropical Malayan forms disappear.* * * The arid flora of the Deccan, of Marwar and Sind, however, hardly enters the Deccan.* * * As a whole the vegetation of Carnatic is neither rich nor varied. The climate being very arid except during the north-east monsoon, the humid flora is entirely absent.* * * The climate of Mysore is much drier than that of Malabar.* * * The vegetation of Mysore, like that of the Carnatic, is rather scanty. The level surface of the tableland is frequently very barren, and the hills are often bare or covered with low scrubby jungle.* * The vegetation of the plain of the Deccan is not very different from that of Mysore. The flora is not extensive, the great drought of the hot season being unfavourable to vegetation."

We have here the botanical features of two of the nine provinces enumerated above comprising about the whole of South India :[2]

(1) Malabar in a very extended sense—the humid belt of hilly or mountainous country extending along the western side of the peninsula from Southern Gujrat to Cape Comorin; and (2) the Deccan in a very broad sense; *i.e.*, the whole comparatively dry tableland of the peninsula east of Malabar and South of the Gangetic and Indus plains together with the Coromandel Coast.

As might be expected, such an extensive area with so diverse botanical features as to constitute two great provinces would be able to make a decent

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[1] Chapter IV, Botany in *Indian Empire*, Vol. I.

[2] *Indian Empire* in Imperial Gazetteer, Vol. I, p. 108.

show of the specimens included in the Sukra Flora. As a matter of fact, a comparison of the Sukra list with the lists for these two provinces in the Botanical volume of the *Bombay Gazetteer* as well as the chapter on Botany in the *Imperial Gazetteer*, would show that almost all of the Sukra Flora have their homes in this whole region taken together. And yet the total strength of the South Indian Flora, even supposing that so varied characteristics can be given to any one type, does not probably come up to that of Bengal (singly considered), and not certainly to the whole Gangetic plain (including Bengal) described above as a really single Botanical area.

So far as the Sukra Flora is concerned, the following specimens seem to be rare in the South:

(1) Feronia elephantum (wood apple).
(2) Mimusops hexandra (râjadana).
(3) Pyrus communis (pear tree, amrita).
(4) Pinus longifolia (sarala, pine).
(5) Juglans regia (akṣota, walnut).
(6) Phylanthus distichas.
(7) Myrica sapida (kâsthâmra).
(8) Diospyros melanxylon (kuddâla, ebony).
(9) Premna integrifolia (agnimantha).
(10) Cedrus or Pinus deodara (devadâru, Himalayan cedar).
(11) Flacourtia sapida (vikankata).
(12) Betula bhojpatra (bhurja).
(13) Boswellia serrata (sallaki).
(14) Stephenia hernandifolia (pâthâ).
(15) Diospyros embryopteris (tînduka).

In the above list of 15 species, the (1), (2), (6), (11), (14) and (15) are not entirely absent from South India. The other nine are conspicuous by their absence. The two Pines, longifolia and deodara, Juglans regia, Pyrus communis, and the Betula bhojapatra are essentially Himalayan, and hence belong to the North Indian type. The remaining four are mainly Sub-himalayan and have their habitats generally in the dry deciduous forests of North India.

(*D*) *Indus Plain Flora and Sukra Flora.*

The absence of the characteristic Himalayan and North Indian species in the southern regions or sub-regions, taken separately or together, is a strong proof against the Sukra Flora being of the southern type. Similarly, we have to exclude the Indus plain, a Botanical province of North India, also from claiming the locale of the Sukra Flora. For though the area is wide enough including the Punjab, Sind and Rajputana west of the Aravalli range and Jumna river, Cutch and Northern Gujrat, and repeats the vegetation of the

Sunderbans at the Indus delta, the flora is less copious and richly diversified and presents essentially the features of arid, deciduous and desert vegetation. The result is, that some of the more important specimens in Sukra Flora which are to be found in humid Gujrat and Bengal are entirely absent from this province.

The determination of the geographical limits of the Sukra Flora, positive and negative, has been guided by both meteorological and botanical considerations. We have had to find out some one province from among the large Botanical Provinces of India, which satisfies both the following double sets of conditions :

(1) A meteorological area which possesses both humid and arid characteristics, and

(2) a botanical area which can command both Himalayan and plain floras.

The first condition can be fulfilled by either the northern or southern region. For, meteorologically[1] speaking, there are two moist regions in India : (1) the western moist region extending from the Gulf of Cambay, and (2) the eastern moist region comprising the Eastern Himalaya with a narrow strip along the outer ranges extending north-west as far as the Ravi &c. Any one of these moist regions together with a neighbouring dry and arid region, *e.g.*, the Peninsular (Deccan), and the area including Eastern Rajputana, a large part of United Provinces up to Cawnpur, &c., can well be the home of the Sukra Flora.

But the second test cannot be fulfilled except by a northern region, as we have seen above.

Hence, by a process of elimination, we get the northern (as well as eastern) moist region together with a neighbouring arid region, *e.g.*, Eastern Rajputana as the natural habitat of the Sukra Flora. The Indus Plain among the nine Botanical Provinces of Hooker is thus excluded as a matter of course ; the remaining portion of Northern India covering exactly the whole of the Gangetic plain, with its upper dry and lower humid regions described above, is the home of the Sukra Flora.

It may be remarked here that this Botanical Province corresponds also to the sub-tropical zone (23°—34° latitude) determined independently by the application of 'Botanical Statistics' to the Sukra Flora.

3. *Literary Evidences.*

The consideration of literary evidences would necessarily lead to a historic treatment of the knowledge of Flora displayed by the makers of Indian literature. Such a study is expected to yield not only a Botanical Geography of India defining within approximate limits the locale of the authors and their compositions, but also a Botanical History of the country giving the approximate periods

[1] For these meteorological divisions, see Brandis' Introduction to his *Indian Trees*, p. xvii,

during which certain plants began to be cultivated and naturalised in different parts of India, whether as imports from province to province or as exotics[1] from altogether alien soils. A history of Indian Botany like that of Indian Mineralogy is thus likely to solve some important questions of Indian Chronology, as they are really parts of the larger history—that of Indian economic as well as political life and institutions.

But, unfortunately, the landmarks of Indian literature, Vedic, Epic, Paurânik, Tantric, Buddhistic, &c., have not undergone that analytical study which may enable one to form an estimate of the progress of the Indians in the knowledge of plants and plant-life. Nor have even individual authors like Pâṇini, Charaka, Vâlmiki, Kâlidâsa, and others been so thoroughly and searchingly studied. The present attempt is, therefore, purely suggestive or tentative, and not at all exhaustive in any sense.

There are, however, two things which should be specially borne in mind in any study of literary evidences:

(1) we have to be perpetually on our guard against the fallacy of *argumentum ex silentio* ; and

(2) we have to discriminate between what is purely a conventional mention or a reference to the permanent stock-in-trade preserved in floating literature which does not admit of any anachronisms and limitations of space, and what is the actual description of the sights and sounds or facts and phenomena in the locality or the region of experiences familiar to the author.

The errors arising from a neglect of these two conditions cannot, however, be easily avoided in the present state of our knowledge regarding things Indian, both physical and human.

A.—Vedic Flora and Sukra Flora.

The *Atharva Veda* is famous for its references to, and hymns about, plants. The usefulness of Flora is known by the reciters of the hymns in the following respects, *e.g.*, against injury and disease and obstruction of urine (I, 2, 3), against leprosy (I, 23), as a love-spell (I, 34), against curses and cursers (II, 7), for victory in disputation (II, 27), against a rival wife (III, 18), for recovery of virility (IV, 4), to heal serious wounds (IV, 12), against witchcraft, and to discover sorcerers (IV, 18, 20 and V, 14, 15), against various evils, enemies and super-human foes (IV, 17, 19, 37), against fever (V, 4), to win and fix a man's love (VII, 38) against a (woman) rival (VII, 113), etc.

The following extracts give a few specimens of the floral lore in the *Atharva Veda* :—

"The berry (pippali)[2] remedy for what is bruised, and remedy for what is pierced—that did the gods prepare; that is sufficient for life."

[1] For an account of these importations from Central Asia, Africa, China, Malaya, America, &c., see Prain's *Vegetation of the Districts of Hughli-Howrah and 24 Pergunnahs* (1905) in the Records of the Botanical Survey of India, pp. 162-166.

[2] Harvard Oriental Series, Vol. 7, p. 360.

"Since thou, O off-wiper (apâmârga),[1] hast grown with reverted fruit, mayest thou repel from me all curses very far from here."

The amulet of *udumvara*[2] bestows various blessings :—

"Rich in manure, rich in fruit, *swadhâ* and cheer in our house—prosperity let Dhâtar assign to me through the keenness of the amulet of Udumvara. * * I have seized all the prosperity of cattle, of quadrupeds, of bipeds, and what grain (there is) ; the milk of cattle, the sap of herbs, may Brihaspati, may Savitar confirm to me. * * * As in the beginning, Thou, O forest-tree wast born together with prosperity, so let Saraswati assign to me fatness of riches.[3]"

The *darbhâ* plant is thus described :—

"Hundred-jointed, hard to be stirred, thousand-leaved, uplifting(?)—the darbhâ that is a formidable herb, that I bind on thee in order to (prolong) life-time. * * * In the sky is thy tuft, O herb ; in the earth art thou set ; with thee that hast a thousand joints, do we increase further our life-time."

The efficacy of the following herbs also is most eloquently dwelt upon—*jangida* (XIX, 34, 35), *satavâra* (XIX, 36), *guggulu* (XIX, 38), *kuṣṭha* (XIX, 39).

The *aśwattha* is invoked against enemies (III, 6) and the *śami* for benefit to the hair (VI. 30). The land is known to be the mother of healing plants :[4] "These three earths (*prithivi*) that are there—of them earth (*bhûmi*) is the highest ; from off their skin have I seized a remedy."

The following is the hymn sung by Viswâmitra for the increase of barley :[5]

"1. Rise up, become abundant with thine own greatness, O barley ; ruin all receptacles ; let not the bolt from heaven smite thee.

2. Where we appeal unto thee, the divine barley that listens, there rise up, like the sky ; be unexhausted, like the ocean.

3. Unexhausted be thine attendants, unexhausted thy heaps ; thy bestowers be unexhausted ; thy eaters be unexhaused."

The following plants are common to *Sukraniti* and *Vedic Literature* :[6] Ficus religiosa, (2) Ficus glomerata, (3) Zizyphus jujuba, (4) Gmelina arborea, (5) Butea frondosa, (6) Acacia catechu, (7) Phœnix sylvestris, (8) Pinus deodara (9) Ægle marmelos, (10) Flacourtia sapida, (11) Acacia suma, (12) Bombax malabaricum, (13) Dalbergia sissoo, (14) Diospyros embryopteris (15) Ficus bengalensis.

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[1] *Ibid*, Vol. 7, p. 432.

[2] *Atharva Veda* (Harvard, Vol. 8), pp. 944-46.

[3] *Ibid*, pp. 947-950.

[4] Harvard Oriental Series, Vol. 8, p. 205.

[5] *Ibid*, Vol. 8, p. 387.

[6] For references to plants in Vedic Literature, see *Vedic Index*, Vol. II, p.590. See also Macdonell's *Sanskrit Literature* (1900), pp. 145-146, and Mr. Bijaychandra Majumdar's *Vedic Names of Plants* in the Kârtik number of the Bengali monthly, *Bhârati* (Calcutta, 1913.)

Of these some are Himalayan species, some are common all-India cosmopolites, and others belong to the more or less dry and arid regions. The Vedic Flora thus indicates the marks of the Indus plain region and the upper Gangetic plain. So far as Sukra Flora partially coincides with Vedic Flora, the common geographical influences must be responsible for this. We have seen above that this area is a part of the larger region covered by the Sukra Flora.

(B) Charaka Flora and Sukra Flora.

Among the fruit-bearing plants, the following species are common to *Charaka Saṃhitâ*[1] and *Sukranîti*: (1) Ficus glomerata, (2) Tamarindus indica, (3) Santalum album, (4) Citrus medica, (5) Nauclea cadamba, (6) Jonesia asoka, (7) Ægle marmelos, (8) Feronia elephantum, (9) Mimusops hexandra, (10) Mangifera indica, (11) Calophyllum inophyllum, (12) Michelia champaka, (13) Phœnix sylvestris, (14) Pinus longifolia, (15) Punica granatum, (16) Juglans regia, (17) Zizyphus jujuba, (18) Azadirachta indica, (19) Myrica sapida, (20) Mimusops hexandra, (21) Pongamia glabra, (22) Areca catechu.

Among the *âraṇyaka*, the following species are common to *Charaka Saṃhitâ* and *Sukranîti*: (1) Acacia catechu, (2) Premna integrifolia, (3) Shorea robusta, (4) Holarrhena antidysenterica, (5) Anogeissus latifolia, (6) Butea frondosa, (7) Alstonia scholaris, (8) Cedrela toona, (9) Cedrus deodara, (10) Carissa carandas, (11) Balanites roxburghii, (12) Boswellia serrata, (13) Gmelina arborea, (14) Stephania hernandifolia, (15) Diospyros embryopteris, (16) Terminalia chebula, (17) Semecarpus anacardium, (18) Calotropis gigantea, (19) Acacia farnesiana, (20) Bombax malabaricum, (21) Terminalia cellerica and (22) Bassia latifolia.

In the above two lists we have 44 species of the 69 in the Sukra Flora, *i.e.*, above 60 per cent. A careful enumeration of all plants in *Charaka* would show a higher percentage. In fact, it would not at all be erroneous if we assert that perhaps the whole of the Sukra Flora is included in the Charaka list of 500 plants divided into 50 pharmacopocial *vargas* or orders of 10 each. It is not safe to define the geographical horizon of the Charaka Flora, at any rate it is certain that, unlike the Vedic Flora, it cannot be assigned solely to the Indus or the Upper Gangetic plain. *Cocos nucifera* does not seem to be included in the list, but *Areca catechu* is there, and this unmistakably points to humid, deltaic or littoral vegetation.

This extension of the Charaka Flora beyond the limits of the Punjab, the home of the first authors of the Charaka cycle, indicates that the whole of Northern India at any rate, if not portions of the South, must have been known from sea to sea. Regular trade in medicinal herbs, cultivation or naturalisation of those that are not indigenous, systematic exploration of forests on hills and in plains, and such like things that take Ayurvedists and druggists out of the limits of any one botanical region and make them more or less cosmopolitan,

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1 For the names of plants in *Charaka Saṃhita*, see the Marathi work on the *Vegetable Flora of India* by Dr. Pandurang Gopal (Poona, 1880).

are implied in the scientific analysis and classification of the vegetable materia medica in the text-book of the Punjab masters.

It must be noted also that the possibility of merely hearsay or conventional references and descriptions of things not personally observed or experimented upon is not unlikely, though it would be well-nigh impossible to assert this dogmatically about one or other of the Charakans, Susrutans, Vâgbhatans, and Chakradattans. Certain it is that in the latter-day schools of medicine the lists became more and more conventional, mere reproductions from the writings of the great masters or Riṣis. There is, however, another important point with regard to the lists of Flora in the successive commentaries or abridgments of the medical encyclopædias. A comparative study[1] of the Indian Pharmacopæias would show that Vâgbhata, Chakradatta. Narahari Pandit and Bhâva Misra, while perpetuating the tradition of their great precursors, have introduced not only new names but also new plants in the treatises prepared respectively for Western India, Eastern India, Mahârâṣtra and Madhyadesa. While therefore, we admit the existence of a conventional floating literature on medicinal plants as on other things, which, like a touch of nature converted the whole of India into a single unit, a common home of the men of letters, and imparted a family likeness and universal or all-India character to the literary productions of educated Hindusthan, we cannot rationally ignore in them the possession, also, of a local colour and provincial physiognomy which can be detected only by the patiently investigating eye of skilful observers.

So far as the Sukra Flora is concerned, we see that its geography is more extensive than that of the Vedic, but less than or perhaps equal to, that of the Charaka. If we notice the flora in points which make them differ, we find that the Vedic and the Charaka are more Himalayan, while the Sukra is more humid.

(C) *Varâha Flora and Sukra Flora.*

In the *Brihat Saṃhitâ* of Varâhamihira, botanical facts and phenomena have been recorded in three chapters. The 29th chapter deals with flowers and plants and is called *Kusumalatâdhyâya.* The 54th is called *Dagârgala* and deals with under-currents, both good and evil, which may be indicated by the position and growth of plants as well as by other things. The 55th chapter treats of gardening and horticulture and is named *Brikṣâyurveda.* The plants mentioned in these three chapters may be taken to be those most familiar to the people of Avanti (in Ujjayini) in the 6th century A.D., for that is the birth-place of Varâha. It may be possible to find out the Geography of the Sukra Flora by comparing the lists furnished in *Brihat Saṃhitâ* about the Ujjayini Flora with those in *Sukranîti.*

[1] Materials for such a comparative study have been furnished by Kavirâj Birajâcharan Gupta of Coochbehar State in the two volumes of the Bengali work, *Vanauṣadhidarpaṇa,* and also in his learned introduction to them.

Among the trees mentioned by the Sukra authors as *phalinah* or fruit-bearing, almost all are referred to by Varâhamihira. Only the following 16 species appear to be special to the Sukra Flora: (1) Tamarindus indica, (2) Santalum album, (3) Citrus medica, (4) Pyrus communis, (5) Myrica sapida, (6) Morus alba or Morus indica, (7)Spondias mangifera, (8) Pinus longifolia, (9) Juglans regia or aleurites moluccana, (10) Mimusops hexandra, (11) Pongamia glabra, (12) Garcinia xanthochymus, (13) Diospyros melanxylon, (14) Phyllanthus distichas or Anona reticulata, (15) Areca catechu, and (16) Cocos nucifera.

Here also one must not be blind to the *argumentum ex silentio.* Mere silence of Varâhamihira does not point to any plants being unknown or at any rate unfamiliar to him and his countrymen. Thus among the species mentioned in Sukraniti there are some which are indigenous to, or may be cultivated and naturalised in, all parts of India, and there is no reason why these should be peculiar to the Sukra Flora and not have been mentioned in the Ujjayini Schedule. Such cosmopolite species are (1) Tamarindus indica, and (2) Phyllanthus distichas or Anona reticulata. Compared with Ujjayini Flora, the peculiarity of Sukra Flora is thus more apparent than real.

There remain now 14 species peculiar to Sukra Flora, and this in a list of 35.

A further process of elimination is necessary to find out how far the Sukra Flora differs from the Ujjayini Flora. The seven species Santalum album, Citrus medica, Pinus longifolia, Areca catechu, Myrica sapida, Mimusops hexandra, Ponganiia glabra and Juglans regia have a place in the Charaka Flora of earlier times. There is no special reason why these should not have been included, at least conventionally, in the Ujjayini list as well, like the cosmopolites we have just referred so.

The peculiar species of the Sukra Flora are thus reduced to six only:

(1) Pyrus communis (amrita)—rare.
(2) Morus alba or indica (tuda)
(3) Spondias mangifera (âmrâ).
(4) Garcinia xanthochymus (tamâla).
(5) Diospyros melanaxylon (kuddâḷa).
(6) Cocos nucifera (nârikela)

Among the *Âraṇyaka* (wild) and *kanṭakina* (thorny) species mentioned by the authors of the Sukra cycle, the following have not been mentioned in the *Brihat Saṁhitâ*: (1) Tectona grandis, (2) Acacia arabica, (3) Garcinia xanthochymus or Cinnamomum tamâla, (4) Holarrhena antidysenterica, (5) Cedrela toona, (6) Cedrus deodara, (7) Flacourtia sapida, (8) Carissa carandas, (9) Betula bhojapatra, (10) Strychnos nux-vomica, (11) Capparis aphylla, (12) Boswellia serrata, (13) Gmelina arborea, (14) Stephania hernandifolia, (15) Terminalia chebula, (16) Acacia farnesiana.

Here, again, we have to note several cosmopolite species which might be included in the Ujjayini list: (1) Tectona grandis, (2) Acacia arabica, (3) Holarrhena antidysenterica, (4) Carissa carandas, (5) Acacia farnesiana,

Thus we have altogether only 11 species which seem to be special to *Sukraniti*; and this in a list of 34.

Here, again, by comparing Charaka,[1] Ujjayini and Sukra Flora we have to eliminate six species from the 11 as special to the last. These are Cedrus deodara, Cedrela toona, Boswellia serrata, Gmelina arborea, Stephania hernandifolia and Terminalia chebula.

Thus we have only five species left as peculiar to the Sukra Flora:

(1) Garcinia xanthochymus (Tâpinchchha or tamâla).

(2) Flacourtia sapida (vikankata).

(3) Betula bhojapatra (bhojapatra).

(4) Strychnos nux-vomica (viṣamuṣṭhi)

(5) Capparis aphylla (kariraka).

In the Varâha list we find that more than 50 per cent. of the Sukra Flora have been actually mentioned. Adding to them the plants that are very common to all parts of the country, and also those which must have been known to Varâhamihira, since they have been familiar even to the Charakans of pre-Buddhistic times, we have left a very small residue that is peculiar to Sukra Flora.

It thus appears that all the Flora mentioned in Sukraniti indicate an age far removed from the days of Islamic and Portuguese influences. On the strength of botanical evidences, other things remaining the same, there can be no objection to placing the Sukraniti during the period indicated by the farthest limit Charaka, and represented by the important land-mark of the sixth century A.D., the *Brihat Saṃhitâ*.

The close coincidence of Varâha and Sukra Flora leads to another important conclusion. This is about the *locale*. We have seen that the *Charaka Samhita*, being a medical work, had necessarily to be more all-India, encyclopædic and universal, so far as the vegetable kingdom was concerned. The Geography of the Charaka is therefore wide as a matter of course. But Varâhamihira, who was writing a treatise to guide the rulers of men, might be expected to be more local and address himself naturally to the needs of his own patron Bhoja, Vikramaditya? of Malwa. The chapters on agri-flori-horticulture in the Brihat Saṃhitâ constitute most probably a section dealing with the *Flora Malwensis* of the 6th cent. A. D. The absence of *Pinus longifolia, Cedrus deodara, Betula bhojapatra* and other purely Himalayan species in the Varâha list points to the local character of the Royal Botanical Garden at Ujjayini. So also the absence of *Areca catechu* and *Cocos nucifera* determines the horizon of Varâha Flora. The Varâha Flora is thus a local Ujjayini collection and represents the Upper Gangetic sub-region of Hooker's Botanical Provinces.

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[1] See the list of Plants in Charaka in *Vanauṣadhidarpana*, a Bengali work in two volumes by Kavirâja Gupta of Coochbehar (1908-1909). Also chapter VII of Gondal's *History of Aryan Medicinal Science* (1896), and Kaviraj Avinâs Chandra Kaviratna's English Translation of *Charaka Saṃhitâ* (1890-96), pp. 13-92.

Besides the close similarity in the lists of Flora between Varâha and Sukra, the very theory of Horti-Floriculture advocated in the treatises raises important issues regarding the time and place of Sukraniti. The two works may be compared on three topics: (1) planting of trees, (2) watering of trees, (3) nourishment of trees. According to the parallel passages and various readings in Mr. Oppert's notes, it appears that the theory of Sukraniti about watering and nourishment is found in only one text—the Bengal manuscript in the possession of Dr. Râmdâs Sen.

Both in matter and language the Sukraniti shows evidences of quotation, incorporation, paraphrasing and adaptation from Brihat Saṃhitâ by copyists or authors who knew geographical conditions more humid and fertile than those in Varâha's place. This has been described in a subsequent section.[1]

The geographical limits common to Vedic, Charaka, Varâhamihiran and Sukra Floras comprise the Upper Gangetic plain, as they include definitely the Malwa regions. The Sukra Flora, therefore, covers this tract together with the northern regions of Himalayan flora and the south-eastern regions of the Lower Gangetic or Deltaic flora.

(D) *Kâlidâsic Flora and Sukra Flora.*

The Flora of Kâlidâsa in the 18 cantos of *Raghuvaṃsam* from the nature of the case is an epitome of the Flora Indica known to the world of letters in his days. Like the *Râmâyaṇam* and *Mahâbhâratam* and many of the Purâṇas, the *Raghuvaṃsam* is an intensely national epic, the embodiment of Hindu India, of its ideals and ambitions, and covers the Geography, Zoology, Botany, Ethnology, and History of Hindusthan from Prâgjyotiṣa on the east to the land of the Pârasîkas on the west, and from the territory of the Kirâtas on the North to the island of Ceylon on the south. The Raghuvaṃsa Flora is, therefore, no touchstone of the Sukra Flora as to its geography, though historically speaking, it supplies a good catalogue of plants, like that in Brihat Saṃhitâ, which were indigenous to and cultivated in India during the period between Hellenistic and Islamic influences.

But the *Meghaduta* of Kâlidâsa in which the cloud has been entrusted with message from a spot in Central India (Vindhyas) to a city on Mount Kailâsa in the Himalayas is more restricted in its botany. "In the first-half of the poem the Yakṣa describes[2] * * * Mount Âmrakuta on whose peak it will rest after quenching, with showers, the forest fires; the Narmadâ winding at the foot of the Vindhya Hills; the town of Vidisâ (Bhilsa) and the stream of the Vetravatî (Betwa); the city of Ujjayini in the land of Avanti; the sacred region of Kurukṣetra; the Ganges and the mountain from which she sprang, white with snow-fields; till Alakâ on mount Kailâsa is finally reached." As might

[1] See *Sukra* IV, iv, 92-93, 105-106, 107-108, 110-112, also p. 237 of Oppert's edition for various readings. *Vide Brihat Saṃhita* LV, 9, 12, 16, 17.

[2] Extract from Macdonell's *Sanskrit Literature* quoted by Mr S. C. Sarkar, M.A., of the Provincial Civil Service in the introduction to his English versical rendering of Meghaduta (City Book Society, 1906). See this work for the interesting geographical and botanical notes collected from the researches of Indian and European Scholars.

be expected, the Meghaduta Flora is more extensive than Varâhamihiran, as it covers the whole ground of mid-Âryâvarta in the longitudinal direction and includes the latter as only one of the types represented in it. The Himalayan flora has a special place in it, as the whole Second Book of the 'Cloud-Messenger' is devoted to a description of the city on Alakâ. But the eastern humid and littoral vegetation is entirely lacking in it.

The 31 species enumerated by Mr. Manamohan Chakravarti[1] as constituting the Meghaduta Flora thus comprise the Malwa (Varâhamihiran) and Himalayan Flora, but exclude the Lower Gangetic. The Sukra Flora coincides in one of its aspects with this whole flora of Meghaduta, but in another respect goes beyond its limits.

The Geography of Sukra vegetation therefore includes that of Meghadutam, *i.e.*, mid-Âryâvarta as a sub-region, and Eastern Âryâvarta as another sub-region, but falls short of that of the Raghuvaṃsam which includes also the India south of the Vindhyas.

4. *Concluding Remarks.*

We have tentatively determined the Geography of the Sukra Flora by three independent evidences:

(1) Botanical Statistics proves it to be 'sub-tropical.'

(2) Ecology (including Meteorology and Phyto-geography) proves it to be 'Gangetic,' according to the nomenclature of Hooker.

(3) Literature or Comparative Botany proves it to be less Himalayan than Vedic and Charaka (and perhaps *Meghaduta*), less encyclopædic than *Raghuvaṃsam*, more Himalayan than Varâha, more extensive than Varâha as including (1) Himalayan and (2) Deltaic, more extensive than Vedic and Meghadutam as including Deltaic, and probably co-extensive with Charaka.

The Vedic Flora represents Indus Plain Province (Punjab, Sindh, etc.), the Charaka, though the work of an inhabitant of the Indus Plain, represents the flora of both the Indus and the Gangetic Plains (of Hooker), as well as of the Himalayas, *i.e.*, the whole of Northern India, Varâha Flora represents Malwa and the Upper Gangetic sub-region, Raghuvaṃsam represents the Flora Indica according to the conditions of Poetic Art, and Meghadutam represents the Upper Gangetic sub-region together with a portion of the Himalayas.

The Sukra Flora thus represents the Upper Gangetic plain, Himalayan regions as well as the humid deltaic and littoral sections of Eastern India.

As for chronology, literary history proves the Sukra Flora to be

[1] Quoted by Mr. S. C. Sarkar in the Notes to his English *Meghaduta*. Mr. Chakravarti takes *Lodhra* to be *Bassia latifolia*. Really it is *Symplocus racemosa*, while *madhuka* would be *Bassia latifolia*. See Griffith's *Specimens of old Indian Poetry* (Pânini Office, 1914) for the whole poem in English verse.

Islamic[1] and does not prevent it from being at least as old as Charaka. Now Pre-Islamic means the period as late as the 8th century in Sindh, 10th century in the Punjab, 11th century in Kanauj (Upper Gangetic Plain) and 12th century (1193 A.D.) at Pātaliputra and Gauda (Lower Gangetic plain). But, as our geography does not take us beyond the botanical limits of the Gangetic plain, the Sukra Flora may be placed at any period between the 6th eentury B.C. and 12th century A.D. And if the fact of incorporation and adaptation from Varâhâmihira be admitted, both the Sukra Flora and the Sukra authors (at any rate, the Eastern copyists of *Sukraniti*) have to be placed after the 6th century A.D.

SECTION 4.

Forestry.

(*a*) *Non-economic.*

The Forests are important items in Indian social economy according to the authors of the Sukra cycle. The third and fourth stages or *âsramas* of Hindu life called *Vânaprastha* and *Yati* or *Sanyâsa* respectively have to be spent in the forests.[2] There are elaborate rules in all Smriti Sâstras regarding this retiring to, and life in, forests. The *Vânaprastha* stage is compulsory on all the four castes, but *Yati* on Brahmanas only. The function of men in the third stage is to restrain passions and activities, and in the fourth is to try to attain salvation.

Forests are the resort of people for non-Sâstric motives also. Among the general rules of morality we are told that one should prefer life in a forest[3]

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[1] It would be interesting to study the history of cultivated plants in India. Such a work should be divided into two branches : (1) Geological—giving an account of the various elemental forces that have led to the existence of Malayan, Chino-Japanese, European, African and even American species in India, and (2) Historical—recording the successive efforts by which Chinese, Persian and European plants have been naturalised in India. Thus we know that tobacco and potato are very modern introductions due to the Portuguese (and other European) nations. So also the Mussalman Emperors were great patrons of Economic Botany, especially of Fruitery. We read in the *Ayeen Akbari* [Glawdin's Translation (1783), Vol. I., pp. 92-99] : "His Majesty is exceedingly fond of fruit ; and by the great encouragement that he has given to the cultivation of fruit-trees, skilful people have come with their families from Persia and Tartary, and settled in this country." See Watt's *Dictionary of the Economic Products of India* and Dymock's *Vegetable Materia Medica of Western India*, for the history and uses of Indian plants. Cf. also, "Opium was first introduced into this country from Arabia. Its spread in India is synchronous with the advent of the Mahomedans who had adopted it as a suitable substitute for fermented liquors, which their religion discountenances. Some more drugs which happened to be introduced into India during the Mahomedan rule are :—Alu (*Prunus bocoriensis*), Badian (*Illicium anisatum*), Baufasha (*Viola odorata*), Gaozban (*Onosma bracteatum*), etc."—*History of Aryan Medical Science* by the Thakur Sahib of Gondal, pp. 125-127. (Edition, 1896).

[2] Sukra IV, iv. 1-5.

[3] Sukra III, 576-577.

to being dependent on others. Then the exile of Râma in a forest[1] by Dasaratha's command also points to the forest being a resort of men. There are also persons who retire to forests[2] after knowing of complaints against them. The law enjoins that the king should summon such people to the court to answer the charge.

The law of the realm has to provide for several classes of cases pertaining to forest. Thus if a bound-down man violates the limitations imposed upon him when crossing a forest[3] or going through a difficult region, he is not guilty and should not be punished. So also in the cases of offences committed in forests[4] *i.e.*, inaccessible regions where human evidences, *e.g.*, witnesses, &c., are not easily available, Sukrâchâryya ordains that divine *Sâdhanas* or ordeals should be resorted to. Then again among the several instances of trial by peers we read that "foresters[5] are to be tried with the help of foresters."

The existence of both religious and legal regulations points to forests being important topographical features of the country of Sukrâchâryya. So they are; for among the general rules we read that (1) one should not visit solitary forests,[6] unoccupied houses, and cremation grounds even by day, and (2) one should always travel with companions, and while travelling, should not take rest on roads or in forests.[7]

That forests are familiar sights to the authors of the Sukra cycle would be evident from the characteristic analogy drawn by them in the following lines. "One should bring to bay or discipline, by the hook of knowledge, the elephant of the senses which is running to and fro in a destructive manner in the vast forest[8] of enjoyable things."

The statesmen of the Sukra cycle, therefore, are judicious enough to devise ways and means for utilising the forests, in order to promote the prosperity and importance of their state. They have prescribed hunting excursions among the functions of the king. "He should sport with tigers, peacocks, birds and other animals of the forest,[9] and in the course of the hunting should kill the wild ones." The *Arthasâstra*[10] of Kautilya is more explicit on the point. We read that Chandragupta had a hunting forest exclusively for his own use. It was provided with only one entrance and had a canal running round it to ward off intrusion. Inside were planted fruit-trees, thornless trees, &c. There roamed at large not only the wilder games, but also some of the wilder ones, deprived of their natural offending weapons. * * * Besides the imperial hunting forest, there was another public forest thrown open to all persons willing to hunt."

The forests are, like mines, important sources of Government revenue according to the financiers of the Sukra cycle. The *Sumantra* or Finance

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[1] Sukra II, 63.
[2] Sukra IV, v. 214-215.
[3] Sukra IV, v, 210-211.
[4] Sukra IV, v, 500-11.
[5] Sukra IV, v, 44-45.
[6] Sukra III, 60.
[7] Sukra III, 124.
[8] Sukra I, 193-194.
[9] Sukra I, 665-666.
[10] Law's *Studies in Hindu Polity*.

minister has to take a census [1] of the forests and study the income accruing from them.

The forests have been utilised by the Sukra statesmen for military purposes also. Among the various classes of forts we have the *vanadurga* or forest fort,[2] which is encircled by huge thorns and clusters of trees. This type of forts is superior[3] to that which is surrounded by ditches and also that which is protected by walls of bricks, mud and stones. It is, however, inferior to the desert-forts, water-forts and hill-forts.

Then an important division of the army seems to consist of people living in forests, who ordinarily are independent and do not perhaps acknowledge the suzerainty of the ruler. The king should, however, be sagacious enough to make use of them for his military defence. The section of the army composed of such recruits is called *sâdyaska*[4] *i.e.*, new or raw, as opposed to the *maula*, *i.e.*, standing or permanent. It is also called *agulmaka i.e.*, one which is not officered and divided into regiments by the state, but brings its own officers and fighting apparatus. The Kirâtas and people living in forests who are dependent on their own resources and strength constitute this division of the state army.

It is one of the counsels of diplomacy to try to win over these forest tribes to one's side by hook or by crook. "Peace should be made even with *anâryas*,[5] for otherwise they can overpower the ruler by attack;" whereas, on the contrary, if the ruler be wise enough to grant them timely concessions, reward, &c., they may stand him in good stead in times of emergency by making the enemy's progress impossible. "Just as a cluster of bamboos cannot be destroyed if surrounded by thick thorny trees, so the ruler should be like a bamboo surrounded by clusters." Such foresters as enter Government service or are otherwise useful to the king should have quarters reserved for them just outside the city limits.[6]

(*b*) *Economic.*

The economic importance of forests now remains to be considered. They are the sources of fuel, fodder, grass and timber. According to the Sukra statesmen the king should lay siege[7] to the enemy's country from such a position as to destroy "carefully the people who help the enemy by carrying wood, water and provisions." The military manœuvres and tactics should also be dilatory and spread over a long period of time—in order that "provisions of the enemy may be cut short and food and fuel diminished." Again, "the powerful should coerce the enemy by stopping the supplies of water, provisions, fodder, grass, &c., in an unfavourable region."

Not only in warlike operations but also in the normal functions of states, Sukrâchâryya recognises the value of forests in the ordinary secular life of

[1] Sukra II, 207-8, 211-212.
[2] Sukra IV, vi, 5.
[3] Sukra IV, vi, 11-12.
[4] Sukra IV, vii, 22-28.
[5] Sukra IV, vii, 482-84.
[6] Sukra I, 506-12.
[7] Sukra IV, vii, 570-73.

the people. The regulations relating to the site[1] for the building of the capital pay due heed to this. The place is to be one which "abounds in various trees, plants and shrubs, and is rich in cattle, birds, and other animals, is endowed with good sources of water and supplies of grains, and is happily provided with resources in grasses and woods." Then, again, the collection of grasses and woods in forests has been recognised as one of the occupations and means of livelihood, and it is important enough to be reckoned in Śukra's comprehensive scheme of taxation. "The king should realise one-third, one-fifth, one-seventh, one-tenth or one-twentieth from the collectors of grasses,[2] woods &c."

Last but not least in economic importance are (1) the *kantakinah*[3] or thorny trees which according to Sukrâchâryya should be planted in forests, (2) *phalinah*[4] or fruit-bearing trees which should be planted very near the village, and (3) other expansive trees, shrubs,[5] creepers, &c., which are to be carefully planted in villages, if domestic, in forests, if wild.

The classification is not at all scientific, as we have noted in a previous section. All the plants enumerated by Sukra might have been mentioned together in one list, for they all belong to the 'Flowering' or *Phanerogam* division according to the Taxonomy of modern Botanists. Economically speaking, again, this classification serves the purpose well so far as it goes, *i.e.*, as a convenient means of knowing which species may be planted in and near the homestead, and which species should be planted at a distance. But it is not the intention of the Sukra authors, nor should we interpret the classification to mean, that the *Âranyaka* or wild and forest flora are in any way less useful to man than those which have been regarded as domestic. For, from the standpoint of Utilitarian Botany, both the classes are of equal importance.

Sukrâchâryya has adopted only one principle of economic classification, *e.g.*, that into domestic and wild. The result is that each of these groups may be sub-divided (*a*) geographically into evergreen, deciduous, or otherwise as we have seen in a previous section,[6] and (*b*) economically into medicinal, industrial, etc.

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[1] Sukra I, 425-428. Cf. Kâmandaki Niti, iv, 50-50.

[2] Sukra IV, ii, 237-38.

[3] Sukra IV, iv, 113-114.

[4] Sukra IV, iv, 103.

[5] Sukra IV, iv, 123-124.

[6] The deciduous forests yield sâl, teak, sandal, ebony, and valuable genera, *e.g.*, Terminalia, Anogeissus, Acacia (Acacia catechu) and other trees that supply the wood oils and varnishes largely used in the domestic life of the inhabitants of the country. * * Among trees characteristic of evergreens may be mentioned Terminalia, Cedrela toona, the wild mango, &c. Pinus longifolia flourishes at lower elevations and finally mixes with the deciduous forests of the plains. See the Chapter on *Forests* in the Economic Volume of the *Indian Empire* in Imperial Gazetteer Series, and *Brihat Samhitâ* LXX 2-4, for Hindu ideas about Timber.

Uses of Plants.

"There is no plant[1] which has no medicinal properties," says Sukrâchâryyâ; and all the plants mentioned by the Sukra authors have one or other use in Hindu Pharmacopœia. The fact that Charaka mentions almost all of these in his *materia medica* points to this.

The Sukra Flora, whether belonging to the domestic or wild class contains:

(1) Timber trees, *e.g.*, Capparis aphylla, Garcinia xanthochymus, Calophyllum inophyllum, Bombax malabaricum, Feronia elephantum, Ægle marmelos, Zizyphus jujuba, Terminalia arjuna, Bassia latifolia, Ficus bengalensis, Ficus glomerata, Ficus religiosa, Phœnix sylvestris, Areca catechu, Dendrocalamus strictus, &c;

(2) Food plants, *e.g.*, Capparis aphylla, Garcinia xanthochymus, Flacourtia sapida, Bombax malabaricum, Ægle marmelos, Feronia elephantum, Mangifera indica, Mimusops elengi, Bassia latifolia, Aleurites moluccana, &c.;

(3) Famine plants, *e.g.*, Bassia latifolia, Ficus bengalensis, glomerata, geligiosa, Santalum album, Phœnix sylvestris, &c.;

(4) Fermented drinks, *e.g.*, Bassia latifolia, Calotropis gigantea, Cocos nucifera, Phœnix sylvestris, Saccharum officinalis, &c.;

(5) Oil-yielding plants, *e.g.*, Bassia latifolia, Semecarpus anacardium, Pongamia glabra, Butea frondosa, Terminalia bellerica, Chebula, Bassia latifolia, Cocos nucifera, Santalum, album, &c.;

(6) Fibrous plants, *e.g.*, Butea frondosa, Calotropis gigantea, Ficus religiosa, bengalensis, Morus alba, Cocos nucifera, Phœnix sylvestris, &c.;

(7) Dyes, *e.g.*, Garcinia xanthochymus, Zizyphus jujuba, Butea frondosa, Acacia arabica, suma, catechu, Terminalia chebula, Woodfordia floribunda, Artocarpus lakoocha, Tectona grandis, &c.;

(8) Gums and resins, *e.g.*, Spondias mangifera, Bombax malabaricum, Feronia elephantum, Mangifera indica, Semecarpus anacardium, Butea frondosa, Terminalia bellerica, &c.;

(9) Vegetable soaps, *e.g.*, Acacia arabica;

(10) Vegetable poisons, *e.g.*, Semecarpus anacardium, Strychnos nux-vomica.

(11) Vegetable antidotes to Snake-bites, *e.g.*, Euphorbia neriifolia;

(12) Fodder, *e.g.*, Dendrocalamus strictus, Cicer arietinum, Ægle marmelos, Cedrela toona, Butea frondosa, Ficus bengalensis, &c.; and

(13) Sacred Flora.

We have to notice in connexion with the economics of Forest Flora that some of the plants in *Sukraniti* are valuable from their uses in religious rites and ceremonies of the Hindus. One of the reasons for the inclusion of Butea frondosa, Calotropis gigantea, Ficus glomerata, religiosa, Mangifera indica, Citrus medica, Melia azadirachta, Ionesia asoka, Ægle marmelos, Michelia champaka, etc., in the Sukra Flora might be due to their importance in Hindu religious life.

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[1] Sukra II, 254-255.

We have not mentioned the various uses[1] which people make of the plants, trees, or shrubs that have not been included in the two lists given by Sukra but referred to incidentally. Some of those plants which have been mentioned casually, *e.g.*, cotton, bamboo, &c., might be well-included in the two lists. The multifarious uses of the cereals, &c., whether as edibles or industrial ingredients, have also been purposely avoided here, since, though they may, like the others, be treated in connexion with forests and forest produce, they have not been mentioned by the Sukra authors separately as forming a class by themselves. All these casual references will be treated in a subsequent section in connexion with the uses made of them by Sukrâcharyya.

It must have been clear from the foregoing account that each of the plants mentioned by the Sukra authors serves more purpses than one, and that it is not possible to make any classification, from the standpoint of Economic Botany, without running the risk of overlapping and cross division. Incidentally also we are led to think that the country of Sukrâchâryya is not a purely agricultural one, but is industrial as well. In fact, among the 64 arts or *kalâs* we have several connected with plants. These come under two heads: (1) Medical Botany and (2) Industrial Botany.

Like mineralogy, Medical Botany is an important branch of Ayurveda; and among the 10 *kalâs* mentioned in this science, we have, according to Sukrâchâryya, the following five pertaining to the vegetable kingdom alone, *e.g.*, (1) distillation of wines and spirituous liquors from flowers, (2) extrication of thorns (3) planting, grafting and preservation of plants, (4) use of preparations from sugarcanes, (5) mixtures of metals and medicinal plants.

Wines.

References to wine and spirituous drinks are frequent in Sukranîti:

(1) One of the 64 kalâs is the distillation of wines[3] and spirituous liquors from flowers, &c.

(2) Three general rules of morality have reference to liquor and enjoin temperance upon the people:

- (i) One should not visit liquor-houses at night.[4]
- (ii) One should not sell liquor.[5]
- (iii) One should not get intoxicated with spirituous liquors.[6]

(3) Drinking, however, is better than other vices:

- (i) "Even the king who is a drunkard[7] is good, but not he who is very angry and addicted to women. For the severe man irritates or alienates the subjects, but the other destroys the

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[1] See the Botanical Volume of the *Bombay Gazetteer*, Economic Volume of the *Indian Empire* in Imperial Gazetteer (Chapters on Agriculture and Forests), and also Watt's *Dictionary of the Economic Products of India.*

[2] Sukra IV, iii, 141-47.

[3] Sukra IV. iii. 141.

Sukra III, 57-59.

[5] Sukra III, 63-64.

[6] Sukra III, 242.

[7] Sukra IV, i, 124-25.

castes only." It is evident that according to Sukra morality the vice which leads to civic and political deterioration or ruin is of a blacker dye than that which touches the social life only.

(ii) "The man who drinks wine[1] is deprived of his intelligence and loses his business." But the result is not very criminal.

(iii) Moreover, "passion and anger are greater intoxicants than wine.[2] Greed is the cause of destruction of the life and property of subjects." Hence the king should give up these three.

(4) With regard to temperance, Sukra authors really follow the *via media.* For rulers as well as for people Sukrâchâryya advises the golden mean :[3]

(i) Of the man who drinks wine excessively, intelligence disappears.

(ii) But wine, drunk according to some measure, increases the talent, clarifies the intelligence, augments patience, and makes the mind steadfast ; but otherwise it is ruinous.

(iii) Sensuousness and anger are like wine and should be duly indulged in—the former for the maintenance of the family, the latter against enemies.

(5) The laws of the land with regard to wines are stated below :

(i) Without the permission of the king, the following are not to be done by the subjects—drinking, distillation of wines.[4]

(ii) The Gânjâ house (liquor house) or tavern should be kept outside the village and the drunkards should be kept there. The king should never allow drinking[5] of liquor in his kingdom in the day time.

Plants in relation to other kalâs.

Besides Agri-flori-horti-arbori-sylvi-cultural facts and phenomena recorded in Sukranîti, there are the industrial[6] or manufactural aspects of Economic *i.e.* Utilitarian Botany referred to casually by the Sukra authors. The *Periplus* mentions, among other articles of trade that passed through the ports on the Arabian and Bengal coasts in the first century A. D., pepper, betel, spice, wine, wheat, sandal, aghil (kind of black aromatic wood). These uses of flora as commercial merchandise, *i.e.*, articles of trade or as raw materials for the thousand and one arts and industries in secular life demand

[1] Sukra IV, i, 126.

[2] Sukra IV, i, 127-120.

[3] Sukra I, 220-233.

[4] Sukra I, 603-8

[5] Sukra IV, iv, 89-90.

[6] See Baden Powell's *Punjab Manufactures* (1872) pp. 74-01, 203-14, Birdwood's *Handbook to the Indian Section* (Paris Universal Exhibition, 1878) pp. 77-79, 83-84, Maffey's *Monograph on Wood Carving* (U. P. 1903) pp. 10-14, Wales' Monograph on Wood Carving (Bombay, 1902) pp. 2-3, also the historical works on Indian art quoted several times.

our attention here. The mention of or allusion to these industrial facts in Sukranîti is to be noticed mainly in the sections dealing with the 64 *kalâs* and with the list of artisans to be maintained by the state, but should also be sought here and there and everywhere in the treatise. References to construction of bridges, boats, cars, chariots, war-implements, arms and weapons, wooden images, temples, palaces, forts, ploughs, &c., as well as other processes and products that point to the utilisation of timber and the art of the carpenter, are instances in point, and bespeak the existence of timber-merchants as well as various grades of wood-carvers and carpenters connected with domestic, religious, architectural, military and agricultural arts.

We have also noted the Ayurvedic preparations from the vegetable drugs of the country mentioned in Sukraniti, as well as the trade in medicinal herbs, suggested by various passages in it. We have already noted the mention of honey as a floral produce.

Other *kalâs* or industries connected with plants are (1) cleansing, polishing, dyeing, &c., of wooden vessels,[1] (2) preparation of boats, chariots and conveyances[2] (3) preparation of threads[3] and ropes, (4) weaving of fabrics by various threads,[4] (5) extraction of oil from seeds,[5] (6) climbing of trees,[6] (7) preparation of vessels with bamboo, straws,[7] &c., and (8) making and preservation of betels.[8]

(c) *Administration.*

Sukraniti thus bears testimony to the varied importance of forests in the economy of social life. The Sukra statesmen, therefore, have organised a special department of the state to look after the interests involved in its vegetable resources.

The department is broadly divisible into two sections: (1) Parks, public grounds or pleasure-gardens and (2) Forests, strictly so called.

The Sukra statesmen advise the king to give away lands for the gods, for parks and public grounds,[9] and for dwelling-houses to the peasants," but for no other purpose. Among the general laws of the land we have, "you must never obstruct the tanks, wells, parks,[10] boundaries, &c." The parks are the

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[1] Sukra IV, iii, 167-168.

[2] Sukra IV, iii, 173. The uses and classes of timber and all such questions relating to the "strength of materials" have been detailed in *Yukti-kalpataru*. This work has been utilised by Râjendralal in his description of Hindu Furniture and Prof. Radhakumud in the *History of Indian Shipping*. cf. also *Brihat Samhitâ*.

[3] Sukra IV, iii, 174.

[4] Sukra IV, iii, 175. See some of the traditions connected with the origin of the weaving art in pp. 2-3 of Silberrad's *Monograph on Cotton Fabrics* (&c. p. 1898), the chapter on Fibrous Manufactures in Baden Powell's *Punjab Manufactures*, pp. 74-91, and Birdwood's *Paris Universal Exhibition* 1878, pp. 88-110. cf. also Thurston's *Monograph on Cotton Fabric Industry* (Madras, 1897) and Twigg's *Carpet making in the Bombay Presidency* (1907).

[5] Sukra IV, iii, 187.

[6] Sukra IV, iii, 188.

[7] Sukra IV, iii, 190.

[8] Sukra IV, iii, 198.

[9] Sukra II, 423-424.

[10] Sukra I, 601-602.

resorts of people as well the king for recreation; and Sukrâchâryya advises the ruler to cultivate social habits in such places. "In parks[1] and places of entertainment, the king should carefully indulge in enjoyments with the people, women, actors, musicians, poets, and magicians." The encyclopædic scheme of general culture devised by the Sukra statesmen is thus adapted to make of the king a perfect gentleman according to the ideas of the time, and quite up to date in notions, tastes, and sentiments.

Parks do not seem to have been insignificant features of social life in Sukra's days. They are important enough to have given rise to special classes of skilled artisans. So the advice is that among goldsmiths, gunners, miners, &c., who deserve the patronage and 'protection' of the state should be included men who "construct parks,[2] artificial forests and pleasure-gardens." Nor is this all; they are also considerable enough to have been regarded as important items of state 'consumption.' The expenditure on parks is also definitely mentioned as one that belongs to the upabhogya[3] class.

The second section of the Forest Department has jurisdiction over forests properly so called. The parks[4] are meant for health, recreation, enjoyment, &c., and constitute the spending department pure and simple; whereas the forests, as we have seen in the previous section, are important sources of national wealth as well as Government revenue. Both these sections, however, are under the management and control of an officer, called the *ârâmâdhipati*[5] or the Superintendent of Parks and Forests. The qualifications of the Forest-officer, according to Sukrâchâryya, should be a sound knowledge of agri-flori-horti-culture. He is to "know the causes of the growth[6] and development of flowers and fruits, the methods of planting and curing trees by the administration of proper soil and water at the suitable time, and the various uses of plants as medicinal drugs."

The Forest-officer is called *kupyâdhyakṣa* in the *Arthasâstra* of Chânakya.[7] He (1) is in charge of the imperial hunting forest, (2) public hunting forest, and (3) has to perform a duty in connexion with the live-stock, *viz.*, the capture, when needed, of birds and beasts that live in the forests under his jurisdiction.

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[1] Sukra I, 661-62.

[2] Sukra II, 83.

[3] Sukra II, 689-91.

[4] See the description of Parks and Forests in *Kâmandaki*, XIV, 27-42. Kâmandaka has devised the scheme of a regulated and restrained indulgence in *Mrigaya* or hunting and sportsmanship for the king, by purposely allowing the construction of such parks and forests. According to him, these are the necessary institutions of a state, and hence inevitable charges upon the public revenues, for otherwise the king may be tempted to undertake "wild goose chase" and indulge in excessive hunting which would thus degenerate into a vicious *vyasana*.

[5] Sukra II, 240.

[6] Sukra II, 317-319.

[7] See in the *Modern Review for August*, 1911, the paper on the Department of Live-stock in Chandragupta's Administration by Narendranath Law.

The great assembly (*Mahâsabhâ*) of the village, the unit of administration in the Chola Empire, was divided into several committees—one of which was elected for the supervision of gardens.

The following extract from Mr. Aiyangar's *Ancient India*[1] gives an idea of the importance of flower-gardens in mediæval Chola life (800-1100 A.D.): "The third published inscription records that a certain Perran Adittan of the Chola country purchased two pieces of land, and made over both pieces to the villagers for maintaining a flower-garden. * * * Having received in full the purchase-money and the revenue of the land and having exempted the flower-garden (and the land assigned) for the maintenance of the garden from taxes for as long as the moon and the sun exist, we the assembly engraved this on stone."

We are not sure if, besides having a knowledge of the matters connected with the *direct* utility of forests, the Superintendent of Parks and Forests in *Sukraniti* and *Arthasâstra* is to have also a knowledge of their *indirect* utility, *e.g.*, "that through the influence which they exercise upon climate, the regulation of moisture, the stability of the soil, the healthiness and beauty of the country and allied subjects." That this topic, however, was not wholly unstudied by the Hindus of yore may be demonstrated by references to Chapters XXIX, LIV, and LV of Varâhamihira's *Brihat Samhitâ*, which, "although an astrological work, contains," according to Dr. Kern, "important astronomical data, and its value for geography, architecture, sculpture, etc., is unequalled by any Sanskrit work as yet published."

In the following section we have quoted Varâhamihira's ideas about the influence of plants on (1) other plants and (2) climate. Varâhamihira's theory of Sylviculture guarantees the forecast of rain, storm, drought, health, famine, destructive fire, disease, &c., from the growth or otherwise of certain plants.

The following extract from *Encyclopœdia Britannica* supplies interesting information regarding Forestry :[2]

" In early times there was practically no forest-management. As long as the forests occupied considerable areas, their produce was looked upon as the free gift of nature, like air and water; men took it, used it, and even destroyed it without let or hindrance. With the gradual increase of population and the consequent reduction of the forest area, proprietary ideas developed; people claimed the ownership of certain forests and proceeded to protect them against outsiders. Subsequently the law of the country was called in to help in protection, leading to the promulgation of special forest law. By degrees it was found that mere protection was not sufficient and that steps must be taken to enforce a more judicious treatment. The teaching of natural science and political economy was brought to bear upon the subject, so that now forestry has become a special science."

The history of forest administration in British India is being given from the same source : " With the advent of British rule forest destruction became

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1 Pp. 100, 104, 109.

2 Article on *Forests and Forestry* in Encyclopædia Britannica, 11th Edition.

more rapid than ever. * * * Then railways came and with their extension the forests suffered anew, partly on account of the increased demand for timber and firewood, and partly on account of the fresh impetus given to cultivation along their routes. Ultimately, when failure to meet the requirements of public works was brought to notice it was recognised that a grievous mistake had been made in allowing the forests to be recklessly destroyed. Already in the early part of the 19th century sporadic efforts were made to protect the forests in various parts of the country; and these continued intermittently; but the first organised steps were taken about the year 1855. * * In 1864 an organised state department was established."

The importance of forests in Indian life is thus described by Mr. S. Eardley-Wilmot, Inspector-General of Forests in the Economic Volume of the *Indian Empire*[1] in the Imperial Gazetteer Series: "The grazing which they annually afford to countless herds assumes a special value in years of drought, when it renders material assistance in saving from starvation the cattle upon which the agriculture of the country depends. They afford the villagers who live in their vicinity a ready supply of material for house-building and thatching, of fuel, and of minor forest products, which add substantially to the comforts of their life. And the use of forest leaves as manure for the cultivator's fields has already assumed large dimensions."

About the Hindu idea regarding Protection of forests and trees we have the following from the *Siddhânta Dipikâ* for December, 1906:—

"Dewan Bahadur R. Raghunath Rao writes in the *Madras Standard* as follows:—I am afraid this is not generally known to the European public what the feelings and opinions of the Hindus are regarding forests and trees. Their religion tells them that trees have souls like men; that cutting down a living tree is as bad as killing a living man; that their twigs, even branches, leaves, when absolutely required, should be removed without any harm to the trees; that only dried trees should be cut down for fuel; that forests should not be destroyed because, in addition to other reasons, they are the residence of the third and fourth Âsramas of the Dwijas; that trees also are the tabernacles of God, and that to plant a tree is a virtuous act, and so on.

"The Hindus do not and cannot therefore advocate the indiscriminate destruction of forests. There is a belief that one is allowed to live in a more pleasant world than this, so long as the trees planted by him here exist. Any indiscriminate destruction of trees is very abhorrent to a true Hindu."

Section 5.

Horti-Flori-Arbori-culture.

The gardener and weaver of garlands are two of the familiar members of the community described by the authors of the Sukra cycle. It is their arts that supply the analogy for a judicious 'exploitation.' Sukra says: "The gardener

[1] See the chapter on Forests for an account of their economic and financial importance in modern India.

collects flowers and fruits,[1] after having duly nourished the trees with care. The collector of taxes is to be like him." Again, "the best king is he who, by following the practice of the weaver of garlands,[2] protects his subjects, makes the enemies tributaries and increases the treasure by their wealth." Further, "the king should receive rent from the peasant in such a way that he be not destroyed. It is to be realised in the fashion of the weaver of garlands[3] and not of the merchant who deals in fuel and firewood."

We have two sets of officers in *Sukraniti* for discharging two kinds of functions in connexion with vegetables:

(1) The superintendent of parks and forests studies the growth and development of plants in *gardens*, parks, forests, &c., and is well up in the *kalâ* that relates to these, and

(2) The superintendent of grains who discovers the good ones by discriminating them from the worthless.

(*a*) *Sukrâchâryya on Practical Gardening.*

The following are the rules about the planting of trees[4] in gardens or forests to be observed by the superintendent :

(1) The good plants are to be placed at a distance of 20 cubits from one another.

(2) The middling plants are to be placed at a distance of 15 cubits from one another.

(3) There should be a space of 10 cubits between two ordinary plants.

(4) The space should be 5 cubits between two youngest plants.

The following rules relate to the watering of plants :[5]

(1) In summer the trees are to be watered twice in the morning and in the evening.

(2) In winter they are to be watered every alternate day (or at mid-day).

(3) In spring they should be watered in the fifth part of the day, in the afternoon.

(4) In the rainy season the plants do not require any watering.

The following rules are to be observed with regard to the nourishment of plants :

(1) Stools of goats, sheep and cows,[6] water as well as meat should be generally used to promote the healthy growth of plants.

(2) In abnormal cases the following recipe is to be tried : "If trees have their fruits destroyed, the pouring of cold water after being cooked together

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[1] Sukra II, 345-46.
[2] Sukra IV, ii, 35-38.
[3] Sukra IV, ii, 222-28
[4] Sukra IV, iv, 91-93. Cf. Brihat Samhitâ, LV, 9.
[5] Sukra IV, iv, 105-106. Cf. Brihat Saṃhitâ, LV, 15.
[6] Sukra IV, iv, 94.

with Kulutha (dolichos biflorus), mâṣa (phaseolus radiatus), mudga, (phaseolus mungo), yava (hordeum vulgare), and tila (sesamum indicum) would lead to the growth of flowers and fruits."[1]

(3) A third process consists in the application of water with which fishes are washed and cleansed.[2]

(4) The fourth recipe is given below : The powder of the dungs of goats and sheep, the powder of hordeum vulgare, sesamum indicum, beef[3] as well as water should be kept together undisturbed for seven nights. The application of this water conduces very much to the growth of all trees in flowers and fruits.

As for the sites where particular plants are to be placed the following are the rules:

(1) Those trees which bear good flowers should be planted very near the village.[4]

(2) A fair garden should be laid out to the left of the dwelling-house.[5]

(3) Those trees which bear thorns, *e.g.*, acacia catechu are known as *Âraṇyaka* and should be planted in forests[6].

(4) Expansive trees, shrubs and creepers are to be carefully planted in villages, if domestic, in forests, if wild.[7]

The knowledge of grafting[8] is certainly one of the qualifications of the gardener, as it is known to be one of the sixty-four *kalâs*.

(b) Varâhamihira on Ecology.

A few notions of the Hindus regarding the connexion between plant life and its environment (both botanical and meteorological) are given below from *Brihat Saṃhitá*,[9] and are to be taken for what they are worth:

(1) Judging from the growth of the fruits and flowers of trees and plants we may determine beforehand what articles can be had cheap and in abundance and what crops will thrive.

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[1] Sukra IV, iv, 107-108. Cf. Brihat Saṃhitâ LV, 16. In the chapter on Empirical Recipes from Varâhamihira, relating to Chemical Technology, Dr. Seal remarks : "It will be seen that these elaborate recipes are empirical contrivances for supplying the requisite nitrogen compounds, phosphates and bacteria, these being potentially contained in the mixtures and infusions prescribed." *Vide* Ray's *Hindu Chemistry*, Vol. II. pp. 285 90.

[2] Sukra IV, iv, 109.

[3] Sukra IV, iv, 110-112. Cf. *Brihat Saṃhitâ* LV, 17-18.

[4] Sukra IV, iv, 103. The plants have been enumerated in a previous section.

[5] Sukra IV, iv, 104. cf. also Bacon's *Essays*.

[6] Sukra IV, iv, 113-114.

[7] Sukra IV, iv, 123-124.

[8] Sukra IV, iii, 144.

[9] See chapter XXIX. 1, 14. cf. also "If mango tree should thrive well, there will be prosperity in the land ; if bhallâta should thrive, there will be fear ; if peolu (Dillenia spaciosa), there will be health ; if khadira and śamî, there will be famine ; if arjuna, there will be good rain. If kapittha should bear blossoms, there will be storm ; if nichula (Barringtonia acutangula) should bear blossoms, there will be drought ; and if kutaja, there will be disease."

(2) There will be good rain in those countries where trees, shrubs and creepers grow luxuriantly with glossy leaves uninjured by worms, but if the leaves should be otherwise there will be little rain.

These two principles sum up what in Varâhamihira's time (6th century A.D.) constituted the results of scientific observation regarding plants (1) in relation to other plants and (2) in relation to the atmospherical conditions. The first has in modern times developed into the science of ecology, and the second into that aspect of the science of forestry or sylviculture which deals with the influence of vegetation on temperature, humidity and climate.

The following interesting extracts from *Brihat Samhitâ* would give an idea of Varâhamihira's economic ecology:

(1) If the sâla tree should bear fruits and flowers, karama (white rice) will grow in abundance; if the red asoka should bear fruits and flowers, red paddy will grow; if the kṣirika should bear fruits and flowers, white paddy will grow; and if the black asoka should bear fruits and flowers, black rice will grow.

(2) The growth of the nyagrodha (the banyan tree) indicates the growth of barley; the growth of tinduka indicates the growth of the sastyaka rice; and the growth of the aswattha indicates the growth of all crops.

(3) The growth of madhuka indicates the growth of wheat, and the growth of saptaparṇa indicates the growth of the barley, etc., etc., etc.[1]

It would be better to describe this Hindu ecology of the early Christian era as Astrological Botany. It may be surmised that the forester, superintendent of parks and the gardener of those days were acquainted with all these notions about the principles of plant life. These look very much like the sayings of the celebrated Khanâ—the most popular agricultural lore of Bengal.

Likewise, the gardener of old must have been familiar with the following views of the scientist of the court of Bhoja Vikramâditya:

(1) The sides of rivers[2] and lakes and other water-banks will not be pleasant and agreeable, if devoid of shady trees.

(2) Soft soil is congenial to the growth of all trees. Such a soil should be selected for the garden, and the sesamum plant should first be grown in it.

(3) Trees that grow without branches shall be grown in the Sisira season, and in the Hemanta shall be grown trees that grow with branches; in the winter season shall be grown trees possessing good trunks.

(c) *Sukra* vs. *Varâha*.

We may compare and contrast the horticutural ideas of Sukrâchâryya with what we may look upon as the practice in the Royal Garden at Ujjayini in the 6th century. We have the following lines in *Brihat Samhitâ*: (1) " In

[1] See Iyer's *Brihat Samhitâ* pp. 138-140. The accounts of plants that by their growth or otherwise indicate rise or fall in the supply of metals, gems, livestock, &c, and prosperity or adversity of certain classes of men, *e.g.*, princes, ministers, &c., should also be noted. cf. also Sen's *Bengali Literature* for the sayings of *Khanâ*.

[2] *Brihat Samhitâ* LV., 1, 2-6.

the dry season[1] the trees shall be watered both in the morning and evening; in the cold season they shall be watered every alternate day (at mid-day?); and in the rainy season whenever the ground is found dry."

The fact that even in the rainy season plants require watering indicates the great absence of humidity in the soil of Malwa for which Brihat Saṃhitâ was probably written; and the fact that the Sukra authors advise no watering during the rainy season points to an opposite state of things—copious rainfall, natural moisture in the soil, &c., known to them. We have also to note that Varâha mentions only three seasons, whereas in Sukra we have six, though with regard to watering of plants only four of them are mentioned. It may be inferred from all this that Sukra's rules are the results of observation of a more humid than the Varâha flora. This would very well suit the topographical conditions of Eastern India.[1]

(2) An interval of 20 cubits[2] between trees is the best; one of 16 is passable; and one of 12 is injurious. The trees that are planted very near each other get their branches interwoven as well as their roots, and such trees get choked and cannot grow well.

But according to Sukrâchâryya intervals of 15, 10 and even 5 are allowed. Here again we may consider the difference to be due to two characteristics of soil,—one being more fertile or humid is more capable of bearing vegetation per foot than the other which is drier and more barren. Sukra's rules therefore are adapted to the topographical features of luxuriant flora, while Varâha's to those of arid vegetation.

The horti-flori-arbori-cultural theories advocated by the authors of the Sukra cycle are thus "relative" to, and indicative of, the botanical conditions of a more humid and productive region than Malwa. This is Eastern India.

The Botanical evidences thus all point to the *locale* of Sukra flora and Sukra authors being somewhere in Eastern India. Comparing the texts of Sukraniti and Brihat Saṃhitâ as regards the watering and planting of trees we may also presume, unless there be other evidences, that:

(1) the difference in treatment is the conscious work of Eastern authors or copyists, and

(2) the authors or copyists of Sukraniti, in quoting passages from Brihat Saṃhitâ or from floating literature, adapted them to the local conditions of the Eastern kingdom.

[1] *Brihat Saṃhitâ* LV, 9.

[1] This would be evident from a comparison of the Sanskrit texts also. Line 105 of IV, iv, of Sukra is exactly the same as the first half of the Sloka 9 of LV of Brihat Saṃhitâ. It is only the second half that differs from each other. It has to be noted again that the lines in Sukranîti (104-112) are to be found in only one of the six texts on which Mr. Oppert edited his book; and that is the text in the possession of Dr. Râm Dâsa Sen of Berhampur (Bengal). The Eastern copyist or scholar in transferring the passage from Brihat Saṃhitâ to Sukranîti adapted the idea to the geographical conditions of his own country.

[2] *Brihat Saṃhitâ* LV, 12-13.

(*d*) *Hindu Phyto-pathology.*

The horticulturist, as we have seen, must know the principles of phyto-pathology and be competent enough to diagnose the diseases[1] of plants and find out the enemies of their proper growth. It is also one of his functions to treat the plants with proper medicines and help forward their natural growth and development. We have already noticed the four recipes of Sukrâchâryya. To these we may add the following four from *Brihat Saṃhitâ*; two of which are similar to those we know :

(1) To cure the tree of these diseases, first scrape off or otherwise remove the parts dead from the tree with a knife; rub over the parts with a mixture of vidanga (Erycibe paniculata), ghee and mire, and pour at the roots water mixed with milk.[2]

(2) "If the fruits are seen to die out, then heat a mixture of horse gram, black gram and mudga, sesamum seeds and barley; after the mixture has fully cooled pour it at the roots. Then the trees will yield increase of flowers and fruits." This is exactly one of the recipes of Sukra.[3] It is to be noted, however, that this is to be found in only one of the texts on which Mr. Oppert based his publication of Sukranîti. This text is that in the possession of Dr. Râmdâs Sen of Bengal.

(3) "Get two *âdhakas* of the excrement of the goat and the ram, an *âdhaka* of sesamum seed, half an *âdhaka* of *saktu*, an *âdhaka* of water, and a

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[1] According to Varâha "cold winds and hot sun produce diseases in trees, and the trees turn white and do not put forth new leaves; the branches become dry, and the juice oozes out." LV, 14.

"The existence of blights and mildews of cereals had been observed and recorded in very ancient times, as witness the Bible, where half a dozen references to such scourges occur in the Old Testament alone. The epidemic nature of wheat rust was known to Aristotle about 350 B.C., and the Greeks and Romans knew these epidemics well, their philosophers having shrewd speculations as to causes, while the people had characteristic superstitions regarding them. Pliny knew that flies emerge from galls. The few records during the middle ages are borne out by what is known of famines and pestilences. Cf. Shakespeare's *King Lear*, Act III, Sc. iv."—Encyclopædia Britannica, 11th Edition, Vol. XXI, (Pathology of Plants).

The following letter to Major B. D. Basu from late Surgeon-General George Bidie, C.I.E. testifies to the practical knowledge of Indian cultivators in phyto-pathology even in modern times: "The achievement on which I place perhaps most value was the discovery of a remedy for the *coffee bores*, which threatened to ruin the coffee industry. The remedy was a simple one, *viz.*, cultivating the coffee under the shade of other trees which protects it from the insect. The native practice in their gardens led me on to this discovery in practical Zoology." (10th July, 1894. Perthshire N.B.)

[2] Brihat Saṃhitâ LV, 15.

[3] *Ibid* LV, 16. Cf. Sukra IV, iv, 107 108. The verse is the same in both treatises except in one or two unimportant words. We may believe rationally that the Bengal Pandit of old interpolated this verse from *Brihat Saṃhitâ* and made it a part of his MSS. of Sukranîti.

tula (100 palas) of cow's flesh. Form a mixture of these, keep it untouched for seven days, and if, at the end of the time, spreading creepers, plants and trees be watered with the mixture, flowers and fruits will grow in abundance."

This, again, is another of Sukra's methods.[1] The languages of the verse in *Sukra* and *Varâha* differ; but, except for the measurements (âdhaka, &c.) given in the latter, the two are substantially the same.

(4). Keep the seeds soaked in milk for 10 days; then rubbing ghee over the hands the seed shall be taken up in the hands and passed from hand to hand till it is covered with ghee. It shall then be rubbed over several times with cowdung and exposed to the smoke of the flesh of the hog and the deer. It shall then be mixed with the serum or marrow of the flesh of the fish and the pig, and when dry it shall be sown in a well-prepared soil and watered with a mixture of milk and water. When it grows, it will grow with flowers.

The similarity between Sukranîti and Brihat Saṃhitâ in the two recipes cannot be interpreted to indicate the priority of the one or the other until other evidences are available. If the Doctrine of Navagraha and Navaratna utilised in Sukranîti be the work of the same age that is responsible for the agri-flori-horti-arbori-cultural section, *Sukranîti* is certainly subsequent to *Brihat Saṃhitâ*, and the Sukra authors must have quoted and paraphrased the two recipes from Varâha or drawn upon the floating literature on the subject.

(*e*) *The Luther Burbank of Hindu India.*

Brihat Saṃhitâ is further interesting to us as giving the methods of producing some botanical wonders. Thus we read (1) how the tamarind and other trees can by proper treatment be made to grow up as creepers, (2) how a plant can be made to grow up full-fledged, like Minerva born *cap-à-pie*, with branches and fruits, (3) how a plant can grow and bear fruits in a day; and so on.

Mr. Chidambram Iyer, translator of *Brihat Saṃhitâ*, adds to the section on Gardening interesting notes derived from a work known as *Brihat Sârangadhara.* This work describes the horticultural processes by which (1) scentless flowers may become fragrant, (2) the cotton-plant will yield cotton throughout the year bright and red as fire, (3) trees will yield flowers at unusual seasons, (4) fruits will grow without bones, (5) fruits will ever remain unripe, (6) fruits will stick to the tree for a very long time; and so on.

The following miracles in horticulture are guaranteed by *Brihat Sârangadhara.*[2]

(1) If the root of the plantain tree be drenched with the blood or serum (of flesh) of the hog or with the decoction of the fruit of the ankola (alangium hexapetalum), it will bear pomegranate fruits.

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[1] Here again, it is only in the Bengal MSS. that we have this recipe. (cf. Sukra IV, iv, 110-112). It is to be easily surmised that the Eastern copyist or scholar incorporated the passage of Varâhamihira with his text of *Sukranîti* in order to make it more important as a manual of gardening, &c. In doing this he, however, does not quote *in toto*, but paraphrases the idea in his own language.

[2] Iyer's *Brihat Saṃhitâ*, Part II, pp. 59-66.

(2) If the plantain tree be watered with a liquid mixture consisting of the flesh, serum, and blood of men and the powdered tooth of elephant and water, the tree will yield mango fruits.

Mr. Edward Lee Greene[1] bears out such ideas of transmutation existing in the western world :

"In this 20th century of our era there are farmers in the world, and not unintelligent, who believe that to some seed of wheat or barley after it has been sown in the field something may happen by which it comes to sprout and grow up into a plant of what they call chess or cheat ; a plant known to botanists as *Bromus secalinus*. * * * The seemingly indicative facts upon which this transmutation theory appears as if it might have established itself in the minds of pre-historic grain-growers were several. * * * Theophrastus does not formally and didactically discuss this question, though he makes a number of references to this changing of one plant into another as something universally believed in his day. * * * It was the metamorphosis attending the development of the individual reptile and the insect which helped to elevate to the dignity of a quasi-rational belief the superstition of the changeability of wheat into lolium."

If the complete transformation of orders and genera be absurd, that of species is not so and has been verified by experiments. With the horticultural miracles guaranteed by Varâhamihira and Brihat Sârangadhara of old we are tempted to compare the epoch-making new creations in plant-life by Burbank, the American plant-breeder of modern times, "which have added to the wealth of nations and enriched the dietary of the race, and have made the world more beautiful." The wonderful achievements of this great and unique genius include among other creations the following : the improved thornless and spineless edible cactus, food for man and beast, to be the reclamation of the deserts of the world ; the primus berry, a union of rasp-berry and black-berry, *the first recorded instance of the creation of a new species* ; a tree which grows more rapidly than any other tree ever known in the temperate zones of the world ; a dahlia with its disagreeable odour driven out and in its place the odour of the magnolia blossom substituted ; a chestnut tree which bears nuts in eighteen months from time of seed-planting.

Regarding the creation of new species Mr. Harwood in his authoritative account of the life and work of Luther Burbank writes : "Should a dweller upon some other planet where some other sun kisses its earth into life come down through space bearing a fruit as yet untasted by the world-men, it would not be more distinctive or more delicious to the taste, than the fruit which Mr. Burbank picked one summer day from a *tree which he had made from three other trees*. For the fruit which he picked was unlike any other fruit which had grown on the earth before—it was absolutely new, he had accomplished

[1] *Landmarks of Botanical History* (Smithsonian Institution, U. S. A. 1906), pp. 135-140.

[2] See *New Creations in Plant-life* by Harwood (Macmillan & Co., 1905).

that which men had said was impossible. So it has been said on other occasions,—such and such things cannot be done. Mr. Burbank says wait; let us see about it.

"He took a wild American plum, a Japanese plum, and an apricot. He bred these three together and made a third, the plumest, different in texture, colour and taste from any other fruit. * * * Indeed there are now opened in many lines of plant-life, by this demonstration of the feasibility of creating new species, possibilities whose scope is limitless."

It seems well nigh impossible to-day to venture describing with any precision the exact character of the new forms and improvements in plant-life that testified to the skill of the practical agriculturists and farmers of ancient India in breeding and selection.

(*f*) *Botany in Fine Arts.*

Sukra authors have not supplied us with much information about these and other branches of Economic Botany, as Râja Bhoja, the author of *Yukti-kalpataru* does. Nor do they refer to the treatment of vegetable motives in art.

Like the metals and animals of the country, the indigenous plants also have left their permanent impress upon Hindu art. The treatment of vegetables in sculpture has been thus remarked upon by Dr. Râjendralâl in *Indo-Aryans*: "The lotus, as may be expected from the circumstance of its being the most gorgeous and handsome flower in India, is by far the greatest favourite, and in Orissa, as elsewhere, occurs everywhere and in various forms—in bud, in a half-open state, and in full-blown flowers. In some specimens the attempt to delineate nature is very nearly successful, but a conventional form is what is generally adopted. * * * The attempt of the Orissan artist to represent vegetable forms will be readily acknowledged to have been much more successful than that of Egyptian and Assyrian sculptors. * * * The Uriya artists depended very largely on the beauty of their vegetable forms for the success of their works, and introduced them as primary, and not as accessory, ornaments in their architecture much more extensively than any other nation of antiquity."

Among the simplest objects of nature pressed into the artists' service in the Ajanta Paintings of the 5th-7th cent. A.D., Mr. Griffiths[1] mentions the "large pink lotus, full-bloom, half-bloom, and in bud, as well as the smaller red and white; the mango (*Mangifera indica*), custard-apple (*Anona squamosa*), a round fruit which may be called the bel (Marmelos ægle) or the lime (Citrus medica); another that looks like the brinjal (Solanum melongina).

The following remarks regarding vegetable life in Hindu art are taken from Vincent Smith's *History of Fine Art in India and Ceylon*:[2] "The use of a long undulating stem, band, garland or roll to break up a long frieze into sections was familiar to Indian sculptors from early days. As seen on Bharhut

[1] Quoted by Smith in *Hist. of Fine Art*, p. 280.

[2] *Ibid*, pp. 384, 386, 388.

coping, the device used is a lotus stem with jack fruits attached. * * * The introduction of the vine into Indian bas-reliefs used to be considered as in itself evidence of copying from Hellenistic models. But that view is not tenable. Sir George Watt believes that the plant is indigenous on the Lower Himalayan ranges, and is even inclined to think that its cultivation may have been diffused into Europe from that region. * * * The Indian aptitude for artistic representation of plant-life certainly was not learned from the Greeks, who could not teach the lesson. Sir George Watt points out to me that the pinnate foliage motives are distinctively Indian."

Mr. Grunwedel[1] in his *Buddhist Art in India* bears the following testimony to the successful treatment of foliage by the Hindu craftsmen: "The Indian plant-world, notwithstanding simple and sometimes even rough modelling, is reproduced with astonishing fidelity to nature. * * * The Hindu sculptor does not care for purely geometrical designs, and so we find frequently creepers with aquatic birds, &c., which, on a smaller scale, fill in the spaces, and are rich and animated with fine observation of nature. * * * Birds flit about among the flowers; and the plant itself grows from the jaws of a sea-monster. * * * In the main, it may be said that these plants, represented in simple lines, with the native animals that animate them—both of which have received purely native modelling—mostly surpass what the celebrated Greek art was able to command: They rest upon a faithful observation of nature."

SECTION 6.

Agriculture.

(a) *Agricultural Occupation, Population, and Tenure*

The means of livelihood[2] enumerated in *Sukraniti* are : (1) learned professions—art of teaching, etc. (2) service, (3) heroism (soldier's art), (4) agriculture, (5) usury, (6) commerce—shop-keeping, (7) industries and arts, (8) begging.

Agriculture is one of the four subjects dealt with in the science of *Vârtâ*. "In Vàrtà are treated (1) interest, (2) agriculture, (3) commerce, and (4) preservation of cows. The man who is well up in Vàrtà need not be anxious for earnings." About the occupation of agriculture Sukrâchâryya's general idea is (1) that it is superior[3] to that of the Vaisyas, *i.e.*, commerce, and menial service of the Sûdras; and (2) that it is too important to be left to a proxy.[4]

Even Brahmans[5] can take to agriculture according to Manu, says Sukrâchâryya.

Among the 64 *kalâs* we have only one connected with agriculture, *viz*, that of drawing the plough.[6] It would thus appear that agriculture was not

[1] English Edition (Bernard Quaritch, London, 1901), pp. 19-20.

[2] Sukra I, 311-12. The two sciences *Vârtâ* and *Dandaniti* together constitute *Arthasâstra* (a variety of Nitisâstra).

[3] Sukra III, 552-54.

[4] Sukra III, 533-34.

[5] Sukra III, 364-67.

[6] Sukra IV, iii, 37.

probably regarded as a *kalá*. Besides, it may be remarked that the country of Sukráchāryya was not purely an agricultural one, but industrial as well.

In agriculture-as in shop, keeping and other occupations, women are to be assistants of males.

Agriculture is also one of the occupations which should be patronised[1] by the state.

The equitable law of Sukra statesmen exempts agriculturists in the harvest seasons from liability to give evidence.[2] Another law with regard to the peasant class is that, like the artists, ascetics, &c., the cultivators should have their disputes decided "according to the usages of their guild,"[3] because "it is impossible to detect them through others' help." The truth and evidences are to be found out with the help of persons born of (*i.e.*, connected with) them. Sukra legislators have mentioned a third law relating to the peasants. This is about joint-stock enterprise which "applies equally to commerce and agriculture."[4] The law is stated below :

"Those who deal in gold, grains and liquids (collectively) will have earnings according to the amount of their share, greater, equal or less." We noticed this law in connexion with metals in a previous section.

It is to be noted that all these secular laws apply to the Mlechchhas[6] also, though they may follow "other masters" in religious beliefs and practices.

About agricultural tools and implements Sukranīti is not a good source of information. We have noticed the plough already. About agricultural livestock we have the following rule :[7]

Brâhmaṇas	should	have	16	cows to	their	ploughs.
Kṣatriyas	"	"	12	"	"	"
Vaisyas	"	"	8	"	"	"
Sudras	"	"	4	"	"	"
Antyajas	"	"	2	"	"	"

There are various kinds of soils with varying degrees of fertility and access to market. The Sukra financiers recognise the consequent variation in Agricultural Returns and have apportioned the Land Revenue in an equitable manner. The following land-laws are what we get about rents, revenues, tenures, &c., affecting the agricultural population of the country :

(1) The king should receive rent[8] from the peasant in such a way that he be not destroyed. It is to be realised in the fashion of the weaver of the garland who, in plucking flowers from plants, takes care that the stock be not exhausted, and not of the charcoal or fuel merchant who destroys the wood altogether.

[1] Sukra IV, iv, 54.
[2] Sukra IV, iv, 85-87.
[3] Sukra IV, v, 206-207.
[4] Sukra IV, v, 35-37.
[5] Sukra IV, v, 618.
[6] Sukra IV, v, 614-17.
[7] Sukra IV, v, 585-87 ; IV, v, 74-77.
[8] Sukra IV, iii, 38-39.
[9] Sukra IV, ii, 222-23. See also Sukra I, 418-19, where the systems of land-measurement according to Manu and Prajápati are compared. Cf. again Sukra II, 345-346.

(2) That agriculture[1] is successful which yields a profit twice the expenditure (including Government demand) after duly considering variations in actual produce.

(3) The king should realise[2] (*a*) one-third from places irrigated by tanks, canals and wells, (*b*) one-fourth from places irrigated by rains, (*c*) one-half from riparian soils, and (*d*) one-sixth from barren and rocky soils.

(4) If people[3] cultivate new lands and dig tanks, canals, wells, &c., for their good, the king should not demand anything of them till they have realised profit twice the expenditure.

(5) Income of the State from Land or Land Revenue is called *Pârthiva*[4] Income (terrestrial). This is various according to the sources, *e.g.*, natural waters, artificial waters, villages, cities, &c.

(6) The king should give to each cultivator the deed of rent[5] having his own mark or seal.

(7) The apportionment and realisation[6] of land-revenue are to be managed in the following way:

(*a*) Having determined the land-revenue of the village the king should receive it from one rich man in advance, or accept a guarantee for the payment of that in monthly or periodical instalments;

(*b*) Or the king should appoint officers, called grâmapas, by paying one-sixteenth, one-twelfth, one-eighth of his own receipts.

(8) If necessary, the king should set apart lands and build houses for peasants.[7]

(9) It is one of the functions of the Sumantra[8] or Finance Minister to study the amounts of land, in cultivation, and out of cultivation, to know the realisers of rent and the amount realised, &c.

(*b*) *The Crops.*

In the preceding sketch we have given all that can be gleaned from *Sukraniti* about cultivation, irrigation, out-turns, Government demand and the agricultural class. We shall now proceed to notice the various plants that have been mentioned by the Sukra authors in the course of their work as distinguished from the fruit-bearing and thorny trees enumerated together, as well as their domestic, industrial or artistic uses which have been recorded in the treatise.

Grains are important like the noble metals, precious stones, &c., and should be hoarded in the treasury. It is one of the duties of the king to study the amounts with the chief of granaries for four[9] muhurtas before meals. These are important belongings of the state and require a department or an officer all

[1] Sukra IV, ii, 224-26.
[2] Sukra IV, ii, 227-30.
[3] Sukra IV, ii, 242-44.
[4] Sukra II, 668-70.
[5] Sukra I, 423-424.
[6] Sukra IV, ii, 247.
[7] Sukra IV, ii, 248-52.
[8] Sukra II, 207-10.
[9] Sukra I, 561-62. 1 Muhurta=48 minutes.

to themselves. He is called *dhânyâdhipa.*[1] His function is to know[2] of the species, measurements, values, essential characteristics of the grains, as well as the methods of consuming, collecting and cleansing them. It is to be noted that winnowing of grains is a *kalâ* or an art, and those who practise it should be maintained by the state.[3]

The following are the rules[4] for the collection and accumulation of grains and provisions:

(1) They should be sufficient to meet the wants of three years, or more.

(2) Only those grains are to be stored up which are well-developed, bright, best of the species, dry, new, or have good colour, smell and taste, the famous ones, durable and dear.

(3) Those grains which have been attacked by poisons, fire or snows (hima) or eaten by worms and insects or those that have been sucked hollow should be used for immediate consumption and not laid by for future use.

(4) Every year there should be new instalments to replace those that have been consumed.

It is evident that the superintendent of the granary is to have such qualifications as will enable him to help the king in discriminating the good ones from the worthless. Like the superintendents of metals and gems who are to be well up in Economic Mineralogy, the officers of the granaries are to be proficient in those branches of Economic Botany which deal with the food-grains, cereals, domestic crops, &c., especially with regard to their life-history, diseases, enemies, &c.

It is to be understood that the grains are stored up not only for ordinary uses in the royal household, but also for the commissariat in times of war. "The king should have forts[5] well-provided with war materials, as well as grains, &c." We have already noticed the importance Sukrâchâryya attaches to grains in warfare.[6] "From the manœuvre of âsana or besieging, the king should destroy carefully those people who help the enemy by carrying wood, water and provisions; and subjugate the enemy through protracted processes by which provisions are cut short, food and fuel are diminished and the subjects are oppressed." We read also: "The powerful should coerce[7] the enemy by stopping the supplies of water, provisions, fodder, grass, &c., in an unfavourable region and then extirpate it."

Besides these references to grains in connexion with the state treasury, royal household, and military operations, there are others which relate to economic interests of people. Thus we have the ruling about joint stock enterprise[8] in grains, as in metals, &c. Again, like the man who counterfeits coins, the man who destroys grains is said to commit an offence that is called

[1] Sukra II, 230.
[2] Sukra II, 313-14.
[3] Sukra II, 408-9.
[4] Sukra IV, ii, 50-50.
[5] Sukra IV, vi, 23-24.
[6] Sukra IV, vii, 570-73.
[7] Sukra IV, vii, 740-41.
[8] Sukra IV, v, 614-18.

Rājajneya or cognisable by the state as against itself, even without any plaintiff. This is one of the 22 cases[1] enumerated by Sukrāchāryya as coming under *crown* vs. *defendants.*

i. The Cereals.

(a) Vrihi.

Vrīhi (*oryza sativa*)[2] is used in rubbing the oyster-pearl soaked in hot saline water during a whole night in order to test if it is genuine or one of the artificial commodities, *e.g.*, those manufactured by the people of Ceylon. Rice[3] is one of the ingredients used in determining the guilt of an offender by *Divya sādhana*, or divine test. The man has to chew without anxiety or fear one *karṣa* amount of rice. The rice-ordeal would declare a man guilty who in chewing the rice experiences difficulties, through palpitation of heart or want of salivation. This ordeal is to be applied in a case involving theft of Rs. 125.[4] There is a law also that the king should not receive milk of cows, &c.,[5] for his kith and kin, nor paddy[6] and clothes from buyers for his own enjoyment.

(b) Godhuma.

Wheat (*Triticum vulgare*) has been mentioned only once. The iron-sheet of which the *kavacha* or armour has to be made should have the thickness of a grain of wheat.[6] "This cereal[7] is essentially a crop of the warmer and drier parts of the temperate zone; but its limits of growth are wide, its varieties being adapted to nearly all climates. In India it is always grown in the cold weather, most extensively in the north and hardly at all in the south."

In Prof. Guha's Bengali translation of Greek *Fragments* of Megasthenes we read of Strabo quoting from Eratosthenes to enumerate some of the cereals and pulses of India sown in the rainy season and winter, and remark that wheat, barley and other crops are unknown to the Greeks (Strabo, XV. i, 13.)

Mr. Schoff thinks (p. 76) that wheat was introduced into India from Egypt. But according to Mr. Jayaswal, the evidence of language is against this view. It came from Persia, or from Mesopotamia (one of its wild homes) through Persia. Its name in India (*Godhuma*) is identical with that in Persia (*Gandum*). Wheat does not figure in Hindu ceremonials, where barley flour and grains are employed. The former is certainly a late introduction.

Mr. Schoff's view was started by Candolle in his "Origin of Cultivated Plants." The section on Habitat and History of wheat in Watt's *Dictionary of Economic Products*, Vol. VI, Part IV (p. 90-91), summarises Candolle's remarks. The Editor's remarks are also very valuable: "There is thus very nearly as strong presumptive evidence in favour of India being the home of some of the forms of wheat as can be shown for any other part of the globe. * * * India possesses perhaps as comprehensive a series of time-honoured forms of wheat as can be shown for any other country. Most of these have been grown for countless ages on very nearly the same fields as they are to be found at the present day."

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1 Sukra IV, v, 165-166.

2 Sukra IV, ii, 126-128.

3 Sukra IV, v, 470-71, 483.

4 Sukra IV, v, 487-90.

5 Sukra IV, ii, 253-54. The reader is requested to read the translation of these lines as given here on p. 149 of Vol. XIII of the *Sacred Books of the Hindus Series.*

6 Sukra IV, vii, 432-33.

7 *Indian Empire* in the Imperial Gazetteer of India. Vol. III. p. 29.

(c) Yava.

Yava or barley (*Hordeum vulgare*) is the third cereal mentioned in *Sukraniti.* It constitutes one of the best articles[1] of horses' food. It is also one of the substances which are to be cooked with water for application to trees whose fruits wither up through disease.[2] The powder of *yava* should be kept together with other grains and beef as well as water for seven nights. The application of this water also conduces to the growth of trees in flowers and fruits.[3]

(d) Pulses.

The pulses have been mentioned by the Sukra authors in connexion with the food of horses. Thus we read that barley and *chaṇaka*[4] (gram or *Cicer arietinum*) constitute the best food for horses; *maṣa* (black gram or *Phaseolus radiatus*) and *makuṣtha* (*Phaseolus acontifolius* or kidney bean) constitute second class food; and *masura* (lentil or *Lens esculenta*) and *mudga* (green gram or *Phaseolus mungo*) are inferior stuff.

Besides these five pulses, we have *harimantha*[5] (peas or *Pisum sativum*) in the following line. : "The horse should be given *harimanthas*, *mâṣas* and *makuṣthas*, both dry and wet, as well as cooked meat."

The seventh pulse mentioned in Sukranîti is *kulutha*[6] (horse gram or *Dolichos biflorus*). Like barley, it is one of the substances used in the preparation of the manure that operates against the tendency of trees to have their fruits withered up, and promotes the growth of healthy flowers and fruits. The other pulses which may also be thus used are *Phaseolus radiatus* and *Phaseolus mungo*.

(e) No Saktu.

Saktu has been mentioned also as a food for horses.[7] "The horse should, after work, be fed upon sugar and Saktu mixed with water." Also, "the horse should be made to take milk, ghee, water and *saktu*." This Saktu is powdered preparation of *Cicer arietinum* and other pulses or hordeum vulgare, &c.

One other pulse has been referred to. That is *niṣpâpa* (*Dolichos lablab*). The two nostrils of an image are to be beautiful like the *niṣpâpa*[8] legume.

(f) Oil-seeds.

White mustard seeds[9] have been mentioned as representing one of the many shapes of feather-rings which are auspicious marks of horses.

One of the 64 *kalâs* is the extraction of oil from seeds.[10] We are not told which seeds. The use of oil for the body is referred to in the following : "The man who appears before the king in the act of rubbing oil[11] commits the offence called *chhala*.

[1] Sukra IV, vii, 285.
[2] Sukra IV, iv, 107-108.
[3] Sukra IV, iv, 110-112.
[4] Sukra IV, vii, 285-86.
[5] Sukra IV, vii, 272-73.
[6] Sukra IV, iv, 107.
[7] Sukra IV, vii, 270-71, 282.
[8] Sukra IV, iv, 224.
[9] Sukra IV, vii, 159-161.
[10] Sukra IV, iii, 187.
[11] Sukra IV, v, 155-156.

(g) *Tila*

Tila[1] (*Sesamum indicum*) is, like the cereal *yava* and the pulses, phaseolus radiatus, and phaseolus mungo, and dolichos biflorus, an ingredient to be used for the preparation that conduces to the growth of trees in flowers and fruits. It may be used in two ways either (1) by being cooked or (2) by being powdered and mixed with beef, cold water, &c., and kept undisturbed for seven days and nights. The flower of the plant is very straight ; and the nose of images[2] is to be like it, if straight, or like the bill of birds, if curved.

The following interesting note is taken from Birdwood's *Handbook to the Indian*[3] *Court* at the Paris Universal Exhibition of 1878: "The phrase *Open Sesame* is from the Indian oil seed, *til*, or *sesamum indicum*, the cultivation of which was carried in the earliest ages into Mesopotamia and Egypt, where it became known under the name of *Semsen* ; and 'open Sesame !' is equivalent to 'Bring in the candles,' 'Light the gas' ; bring light, which opens everything, which neither wheat nor barley could give Cassim, but only the oil seed Sesamum."

Mustard (*Brassica campestris*) has been referred to as the specimen of very small substances. "To the good man even a very insignificant benefit rendered appears very high, while the wicked man considers a service even less in amount than a mustard seed to be huge."[4]

ii. Other Plants.

(a) *Sugarcanes.*

Sugarcanes[5] (*Saccharum officinarum*) are the plants which give rise to one of the sixty-four *kalâs*. The following is taken from Birdwood's *Paris Exhibition*[6] (1878) : "Sugar was introduced into Europe by the Saracens and through the Crusades. * * * All the European names for Sugar are derived from Sanskrit *Sharkara*, through the Arabic *Shakar*, the Hindu name of sugar. * * * Undoubtedly sugar was made from time immemorial in India. * * Nearchus quoted by Strabo (XV. 1, 20) says that in India 'reeds yield honey, although there are no bees.'

(b) *Bamboos.*

Bamboos[7] (Dendrocalamus strictus) also give rise to a *kalâ*—the preparation of vessels with leaves and straws of the plant. Bamboos are known to be one of the sources of pearls.[8] It is also stated that the king should win over the forest tribes to his side, and be like bamboos[9] surrounded by clusters of thick thorny trees.

(c) *Tula or Cotton.*

Cotton (*Gossypium herbaceum*) has been referred to twice to serve the purpose of analogies for light insignificant substances. "The untrained, inefficient and raw recruits are like bales of cotton.[10] The wise should appoint them to other tasks besides warfare." Again, "The king cannot be restrained by the councillors, for they are his servants, just as the elephant cannot be bound by thousands of bales of cotton."[11]

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[1] Sukra IV, iv, 107-108, 110-112.
[2] Sukra IV, iv, 223.
[3] P. 24.
[4] Sukra III, 610-20.
[5] Sukra IV, iii, 146.
[6] See pp. 31-33, for the interesting history of sugar in both East and West.
[7] Sukra IV, iii, 190.
[8] Sukra IV, ii, 117-18.
[9] Sukra IV, vii, 482-85.
[10] Sukra IV, vii, 356-357.
[11] Sukra IV, vii, 832-838.

Mr. Schoff in his newly published edition of the *Periplus* (Pp. 71-76) adds the following note:

"Sansrkit, kârpâsa; Hebrew, carpas; Greek, karpasos; Latin, carbasus—the seed-fibres of Gossypium herbaceum and G. arboreum (order, Malvaceæ) native in India, and woven into cloth by the natives of that country before the dawn of history. The facts concerning it have been admirably stated by Mr. R. B. Handy in *The Cotton Plant*, a report of the U. S. Department of Agriculture, issued in 1896. Cotton thread and cloth are repeatedly mentioned in the laws of Manu, 800 B.C. Professor A. H. Sayce in his Hibbert Lectures shows ground for the belief that it was exported by sea to the head of the Persian Gulf in the 4th Millennium B.C.; and it found its way very early to Egypt. Herodotus describes it as a wool, better than that of sheep, the fruit of trees growing wild in India.

"The manufacture of cotton cloth was at its best in India until very recent times, and the fine Indian muslins were in great demand and commanded high prices, both in the Roman Empire and in Mediæval Europe. The industry was one of the main factors in the wealth of ancient India, and the transfer of that industry to England and the United States, and the cheapening of the process by mechanical ginning, spinning and weaving, is perhaps the greatest single factor in the economic history of our own time."

In Prof. Rajanikânta Guha's Bengali translation of the original Greek *Fragments* of Megasthenes we read of Eratosthenes referring to wool yielded by a kind of tree. Prof. Guha also mentions Herodotus as having noted this fact, and remarks that this undoubtedly points to kârpâsa or cotton plant.

Prof. Mookerji quotes from the eighth volume of *Nihon-ko-ki* and 199th Chapter of *Ruijukokushi*, two Japanese State records, to prove that about 799-800 A.D., "Cotton was introduced into Japan through the Indians who were unfortunately carried over to that country by the black current." *Indian Shipping*, p. 174.

(*d*) *Arka.*

Besides cotton, another fibre-plant has been noticed. This is arka (*Calotropis gigantea*), but its use in *Sukraniti* is for a quite different purpose.[1]

The Calotropis gigantea, the Euphorbia neriifolia, Allium sativum, Indigofera tinctoria, and Pinus longifolia have been mentioned as plants useful in the manufacture of gunpowder,[2] as supplying both charcoal and juice. We have already described the recipes in the section on minerals.

(*e*) *Indigo.*

The antiquity of Indian Indigo can be inferred from the following lines in the *History of Indian Shipping* (p. 91): "Further, according to Wilkinson, the presence of indigo, tamarind wood, &c., has been detected in the tombs of Egypt, and Lassel has also pointed out that the Egyptians dyed cloth with indigo."

(*f*) *Betel.*

Among narcotic plants we have betel (*Piper betle*) and *gânjâ* (*Cannabis sativa*). The preparation and preservation of betels constitute one of the sixty-four *kalâs*.[3] Men skilled in the preparation of betels[4] have been mentioned among the artists and artisans who should be encouraged by the king.

[1] Sukra IV, vii, 400-415.
[2] Sukra IV, iii, 198.
[3] Sukra II, 410-11.
[4] See Birdwood's *Paris Universal Exhibition*, p. 23.

One of the *chhalas* or offences against social etiquette is known to be the act of taking or chewing betel,[1] before being presented with it by others.

Betel-leaf has ever been an important item in the socio-economic life of South India. We have seen the trade in betel mentioned by *Periplus.* An inscription[2] bearing on mediæval Chola life (800-1100) records: "The great men elected for the supervision of the tanks shall be entitled to levy a fine of one Kalanju of gold in favour of the tank-fund, from those betel-leaf sellers in this village, who sell betel-leaf elsewhere but at the temple of Pidari."

(*g*) *Gânjâ.*

The *gânjâ* house has been mentioned as a generic term for taverns and resorts of people who take to spirituous liquors, intoxicants, narcotic drugs, &c. "The king should build the *gânjâ* house[3] outside the village and there keep the drunkards, and should never allow drinking of liquor in his kingdom in the day time."

No intoxicant plant has been referred to in the *Sukraniti* as such, but we have noticed in a previous section that Cocos nucifera, Phœnix sylvestris, &c., are such liquor-yielding plants. Tobacco (Nicotiana tabacum), Poppy (Papaper somniferum), &c., have not been mentioned.

(*h*) *Lotus.*

Lotus or *Nelumbium speciosum* is the plant whose flowers are the favourite resorts of bees. "The bee that has the power of cutting holes and can fly with wings, gets, however, caught within a lotus,[4] because of its desire for smell." Lotuses,[5] when newly blossomed, are favourites of the moon also. Lotus is one of the things in the hands of *Viṣṇu.* "The *sâttwika* form of Viṣṇu's image is to have hands indicating blessings and courage, and possessing conch and lotus."[6] The lotus is sacred also to the gods, Sun and Gaṇesa.

(*i*) *Citron.*

Mâtulunguka or citron (*Citrus medica*) is the plant which, like lotus, is sacred to the gods.[7] A fruit of this plant is to be placed in one of the four hands of Lakṣmi.[8]

(*j*) *Rati* (Abrus precatorius).

Kṣumâ[9] and *rati* are seeds important in measurement of metals, precious stones, &c. The standards of weights and measurements will be treated of at length in a subsequent chapter.

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[1] Sukra IV, v, 153-164.
[2] Aiyangar's *Ancient India* p. 101.
[3] Sukra IV, iv, 80-90.
[4] Sukra I, 211-212.
[5] Sukra I, 323-324.
[6] Sukra IV, iv, 206, 301-302, 275-278, 298-99.
[7] Sukra IV, iv, 275-278.
[8] Sukra IV, iv, 300.
[9] Sukra IV, ii, 130-144.

SECTION 7.

Botany as Science.

Elementary notions of Theoretical Botany are to be met with here and there. Thus we are taught that "inferiority and superiority[1] depend sometimes on the qualities of the seed, sometimes on the character of the field. But excellence is due to both." This is all that we have of *abstract* Ecology.

According to size and shape we have the following classes of plants, besides trees:

(1) *Latâh*,[2] which do not flourish without resting grounds.

(2) *Stambinyâh*[3] or bushes.

(3) *Gulminyah*.[4]

The trees are (1) thorny and (2) fruit-bearing;[5] or (1) wild and (2) domestic. This is the sole Dendrology of the Sukra authors.

All the seven parts of a plant are known and have been mentioned in the right scientific order, *e. g.*, root, stem, branches, leaves, flowers, fruits and seeds. Thus "the king is the root of the state, the councillors are the stems or trunks, the commanders are the branches. The troops are the leaves and flowers; the subjects are fruits, and the lands are seeds." Of course the fanciful analogy between the vegetable organism and the political organism is to be taken for what it is worth. It has its parallel in the fictitious analogies drawn between the body politic and other organisms by mediæval political thinkers of Europe.

The importance of the root in the life-scheme of the plant is thus indicated: "Just as the branches of a tree wither up when its roots[6] decay, so also without the king, the commanders, &c., grow powerless immediately or in course of some time."

Sukra statesmen know of only one form of political organism—the monarchical. And therefore the loss or absence of the king means a decay, if not complete revolution, of the kingdom.

The root has occupied an important place in the history of Botany in the west also.

"Throughout the whole period of Greek antiquity[1] there was a class of men who followed as a regular business the gathering, preparing and selling of roots and herbs that were of repute in medicine. * * * It was the example of the rhizotomists, in their books of plant-description extant in the times of Aristotle and Theophrastus, that impelled Theophrastus and others after him to give the form, texture, colour, odour, flavour, as well as the active properties, when these were known, of the roots or underground part of almost every

[1] Sukra IV, iv, 78-70.
[2] Sukra I, 767.
[3] Sukra IV, iv, 123.
[4] Sukra IV, iv, 123
[5] Sukra IV, iv, 91-93.
[6] Sukra V, 24-26.
[7] Sukra V, 22-3.
[8] Greene's *Landmarks of Botanical History*, pp. 48-51.

plant. * * From Dioscorides and Pliny down through the middle ages and out to near the end of the seventeenth century authors in general described and figured the roots of every weed and grass and bush and tree. * * * It was Valerius Cordus, the greatest if not the only botanical genius of the first half of the 16th century, who first gave expression to the opinion, that, from the morphologic and phytographic point of view, the importance of the root had always been over-estimated. He set the example for a reform of descriptive botany in this particular; but, as usual with men of genius, he was a century in advance of the ideas of the multitude."

SECTION 8.

A Preliminary Survey of Hindu Botany.

1. *Lines of inquiry.*

The data of ancient Indian Botany from the Nitisâstra of Sukrâchâryya have supplied us with information regarding the knowledge of the Hindus in several branches of Economic, Utilitarian or Applied Botany, *e.g.*, Sylviculture, Horticulture and Agriculture. The authors of the Sukra cycle have mentioned also the botanical *Kalâs* or vegetable arts and industries auxiliary to Ayurveda, the Science of Medicine, but have not otherwise devoted much attention to the Medical branch of Economic Botany. We have noted likewise that for Theoretical Botany or Botany as an abstract science, Sukranîti furnishes very few materials and has thrown out only vague hints here and there. This is inevitable, since the subject of plants and plant-life touches the province of Nitisâstras solely from the utilitarian stand-point.

If we take "the most extended use of the term, all information about the plant-world or any part of it is Botany.[1] According to this view, all. treatises upon agriculture, horticulture, floriculture, forestry, pharmacy, in so far as they deal with plants and their products, are botanical." All earlier historians[2] of Botany in Europe have proceeded to their work on the theory "that for the earliest intimations of anything looking in the direction of the science of botany we must have recourse to those oldest pieces of literature in which plants are more or less freely mentioned. Adanson, for example, does not begin botanical history without naming Orpheus, Musa, Solomon, Hesiod, Homer, Metrodorus, and Hippocrates, who as poets or physicians wrote of plants. Sprengel has among his initial chapters one bearing the title 'flora Biblica,' another 'flora Homerica,' another 'flora Hippocratica.'"

The historian of Hindu Botany may, therefore, safely look upon Vedic Literature, Charaka Samhitâ, the Aṣṭâdhyâyi of Pâṇini, the Râmâyanam, the Mahâbhâratam, the Jâtakas, the Purânas, the Tantras, the scientific works of the schools of grammar, astronomy, medicine, and lexicon, the poetical works of Bhâsa, Kâlidâsa and others, the Nitisâstras, and other treatises of Sanskrit

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1 *Landmarks of Botanical History*, Part I. By Edward Lee Greene (Published by the Smithsonian Institution, U. S. A. 1900) Preface p. 7.

2 *Ibid.* Chapter I, p. 20.

literature as important landmarks in the history of knowledge regarding plants, and give to some of his chapters such titles as 'flora Vedic,' 'flora Charakensis' 'flora Malwica,' 'flora Sukrensis,' and so on.

Botany, *as a science*, however, must rigidly demarcate itself from such utilitarian or poetic treatment of plants, but occupy itself with the "contemplation[1] of plant as related to plant and with the whole vegetable kingdom as viewed '*philosophically* in its relation to the mineral on the one hand, and to the animal on the other." Such purely botanical studies *i.e.*, abstract researches regarding plants *as plants* rather than as things useful or deleterious to man and beast, are pre-eminently modern. This would be evident from the following extracts from the articles bearing on the history and evolution of the science in *Encyclopaedia Britannica*:[2]

"Little, however, was done in the science of Botany, properly so called, until the 16th century of the Christian era, when the revival of learning dispelled the darkness which had long hung over Europe. * * * The descriptions in these early speculations were encumbered with much medicinal detail, including speculations as to the virtues of plants. Plants which were strikingly alike were placed together, but there was at first little attempt at systematic classification. * * * The foundation of botanic gardens during the 16th and 17th centuries did much in the way of advancing botany. They were at first appropriated to the cultivation of medicinal plants. This was specially the case at the Universities where medical schools existed. * * * Robert Brown (1773-1858) was the first British botanist to support and advocate the natural system of classification. * * * The study of plant anatomy was begun in the middle of the 17th century as a direct result of the construction of microscopes. * * * The subject was practically dormant for nearly a century and a half: it was revived by several German workers * * * at the beginning of the 19th century. * * * The pioneer of modern plant anatomy was Hugo von Mohl (1840). * * * In its systematised form, as a branch of botanical study, Phytopathology is of recent date; and, as now understood, the subject first received special attention about 1850, when the nature of parasitism began to be intelligible.[3]

"One of the earliest workers at Plant Physiology[4] was Hales (1727). * * * The birth of Modern Chemistry in the work of Priestley and Lavoisier, at the close of the 18th century, made possible the scientific study of Plant-nutrition * * * The department of geographical Botany made rapid advance by means of various scientific expeditions which have been sent to all quarters of the globe, as well as by individual effort since the time of Humboldt."

The above extracts regarding Systematic, Physiological, Geographical

[1] *Ibid.* Preface. p. 7.

[2] 11th Edition Vol. 4, p. 200.

[3] Vol. XXI, pp. 743-5, 754.

[4] Vol. IV, p. 202.

and Anatomical branches of Botany,[1] considered as an abstract science, show the essentially modern character of this division of human learning. Botany, as we have it to-day, is in reality only as old as the second decade of the last century. In comparing botanical ideas of the Hindus with those of the western peoples we cannot, therefore, too carefully remember the fact that these are embodied in Sanskrit treatises which are mostly several centuries older than even the crude beginnings of European scientific thought due to the Renaissance of the 16th century.

Whatever be the value of Hindu botanical theories, they are well worth the attention of the historian of botanical science for a proper estimate of the mile-stones in the culture-history of mankind. The data of botany *as science* from Hindu literature would thus supply some of the missing links in the concatenation of diverse facts and ideas that go to make up the complex web of human civilisation.

We have noticed above that in Europe botany began and grew as the handmaid of, and in subordination to, the science of medicine. The story is repeated in India also. The botanical literature of the Hindus is mainly pharmacopical, and essentially utilitarian or economic, at times poetical, scarcely *scientific*. And yet it is possible to glean from the vast mass of literature on industrial or applied botany and horticultural recipes the really scientific conceptions of the Hindus regarding (1) Vegetative organography, (2) Anthology, (3) Fruit and seed, (4) Anatomy, (5) Phytography, (6) Taxonomy, (7) Nomenclature, (8) Ecology, and (9) Dendrology.

Thus, according to Greene, "there are certain rudiments of a *science* of botany in those ancient pieces of literature, the real substance of which those authors of botanical commentary on the Bible, on Homer, on Virgil, and the classics generally, have completely overlooked. Let me repeat it that in several pieces of very old literature there are legible traces of a science of botany."[2] For, consciously or unconsciously, scientific botany must be as old as human history, and as extensive as the races of men. The records of antiquity[3] as well as of the most untaught people of modern times afford abundant proof of the existence of organology of plants, systematic botany &c.

By laborious researches into the botanical literature of antiquity, Mr. Greene has traced the evolution of Scientific Botany through the usages and rites of the *rhizotomi* or root-gatherers to the *Historia Plantarum* of Theophrastus (B. C. 370-286) whom he holds up as the "maker of the first landmark in the history of Botany," and "the discoverer and first promulgator of the elements of universal botany."

[1] See also the English Edition of *History of Botany* (1530-1860) by Prof. Sachs of Wurzburg (Clarendon Press, Oxford 1890). Book I. History of Morphology and Classification, pp. 3-13; Book II. History of Vegetable Anatomy pp. 219-229; and Book III. History of Vegetable physiology, pp. 350-76. Greene's *Landmarks* (Part I) is a study of certain epochs in the Development of the Science of Botany prior to 1502.

[2] *Landmarks*, pp. 20-21.

[3] See Greene's *Landmarks*, pp. 21-43 for evidences.

It may be possible, by following the self-same method in the investigation of the botanical documents of Indian literature, to bring out the contributions of the ancient Hindus to the universal scientific botany of to-day. And probably Greene's remark[1] about Theophrastus may have to be applied with equal Cogency to charaka and other founders of the schools of medicine in the Pre-Buddhistic and Buddhistic ages of Indian history (6th cent. B. C.) :—

"To me it seems not improbable that historians of the future, learning to know this great founder's mind better than is yet known, may agree in some judgment not unlike this: that all that has been added to the understanding of Plant life and form—to morphology, anatomy, physiology, perhaps even to taxonomy—within the last three centuries—has been due to the inventions of the opticians, and to the increased number of students and investigators, rather than to the appearing on the botanical horizon, within the modern period, of any one mind in powers of observation, penetration, and sagacity superior to Theophrastus of Eresus."

The so-called " Indian Botany " of to-day.

To do for ancient Hindu sages what Mr. Greene has done for Theophrastus would require (1) a knowledge of the fundamental principles of modern scientific Botany, and (2) a thorough familiarity with the several branches and landmarks of Indian Literature. Unfortunately, the trend of University Education in modern India has been to absorb the whole attention of the student-folk in mastering the technicalities of a foreign tongue ; and, while it has deprived them of sound scholarship in oriental subjects, it has not equipped them with genuine mastery in any modern European science. And so far as Botany is concerned, it has until recently been grossly neglected, whether in its theoretical or economic and applied branches. The result has been a complete absence of interest on the part of Indians in things Botanical, abstract or utilitarian, modern or ancient.

When Europeans began to study the plants of India, they did not naturally care to inquire into the traditions of Hindu Botany and could not at all be interested in developing what the children of the Indian soil had achieved in this department of learning in the days of yore. They came out to India as medical men, botanists, or foresters and industrialists, and found in India a rich field for applying or correcting and modifying the systematic and ecological ideas that obtained currency in Europe of the later 18th and

[1] To those who would take up the historical investigation into the really scientific contributions of the Hindus in the field of Abstract Botany, the chapter on *Theophrastus* in Greene's *Landmarks* is invaluable as suggesting not only the methodology, but also the lines of inquiry that would be required to bring into forefront the hitherto neglected pioneers of science. It is remarkable that Theophrastus, whom Greene elevates to the dignity of "Father of Botany" in 1909, was only casually noticed by Dr. Sachs in his celebrated History of Botany, published in 1875, which the translator for Clarendon Press, Oxford, regarded as a "masterly sketch" even in 1890.

early 19th centuries. India was to them a laboratory that supplied novel and interesting data for the inductive generalisations of a science that had been developing in Europe from Theophrastus to Linnaeus. The Botanical investigations of these Europeans in India were thus new contributions to the already growing fund of European Botany and flourished absolutely independent of what the ancient Hindu masters might have observed and recorded, preserved and developed till the days of the Maratha hegemony.

The terms "Indian Botany" and "Indian Forestry" are thus really misnomers, for they do not indicate anything beyond the fact that the rich flora lying within the geographical limits of India have been identified, named, registered, tabulated and described, botanically or economically, according to the terminology, nomenclature and taxonomy of a science that was then passing through its infantile stages. The sole interest of the pioneers of the so-called "Indian Botany" was identification and botanical description of the vegetable denizens of India in the interest of European science, industry and commerce.

In 1790 Sir William Jones, founder and first President of the Asiatic Society of Bengal, gave a discourse on the medicinal plants of India in which he clearly indicated the lines of work that should be followed by botanical explorers and writers:—"Some hundreds of plants, which are yet imperfectly known to European Botanists, and with the virtues of which they are wholly unacquainted, grow wild on the plains and in the forests of India. The *Amara-koṣa*, an excellent vocabulary of the Sanskrit language, contains in one chapter the names of about three hundred medicinal vegetables ; the *Medinī* may comprise many more; and the *Dravyâbhidhâna* or Dictionary of natural productions, includes, I believe, a far greater number ; the properties of which are distinctly related in medical tracts of approved authority. Now the first step, in compiling a treatise on the plants of India, should be to write their true names in *Roman* letters, according to their most accurate orthography, and in *Sanscrit*, preferably to any vulgar dialect ; because a learned language is fixed in books, while popular idioms are in constant fluctuation, and will not perhaps be understood a century hence by the inhabitants of these Indian territories whom future botanists may consult on the common appellations of trees and flowers."[1]

The founder of the first oriental research society in India was naturally anxious to do spade-work[2] for enriching European art, industry and science. Exactly similar were the motive and enthusiasm that inspired the *Flora Indica* (1855), the monumental work on Indian Botany, prepared at Kew, under the direction of Dr. Hooker, at the chief cost of the Secretary of State for India.

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[1] *Asiatic Researches*, Vol. II, XXII. pp. 270-271.

[2] Another such modern misnomer is *Indian Economics*, a term which does not seem to mean anything beyond the description and cataloguing of the present day economic resources and organisations of the country.

In 1874 Mr. C. B. Clarke, in the Preface to the Reprint of Roxburgh's pioneer-work[1] on Indian Plants, describes the merits of Hooker's labours which were directed mainly to a proper identification and cataloguing. "The Kew Indian Flora is of the highest value to Botanists, it tells those in India what material there is at Kew and *how the names are arranged*[2] there. And it will, when finished, form the foundation on which all future botanic work in India will be grounded. After the plants have been botanically *determined* and the *names attached, so that we are tolerably sure in general that we all mean by the same name the same thing,* we may commence economic and other branches of investigation with advantage. Drs. Hooker and Thomson have rightly urged that the Botanical determination of the plants must come first before any satisfactory progress elsewhere can be made ; and Indian Botanists have been right for generations in concentrating and narrowing their work in the manner that Drs. Hooker and Thomson indicated."

Identification and Determination of Indian Plants were thus the principal objects of the founders of the so-called "Indian Botany." There were some investigators who were not content with mere cataloguing and botanising, but added to these a study of the economic uses of Plants, as medical drugs or otherwise. Thus, to quote Mr. C. B. Clarke again, "Roxburgh contains all the economic Indian botany known to him. * * * Roxburgh is most trustworthy in his economic botany. * * * The Government of India but a few years back, called on Mr. Kurz to draw up a Forest Hand Flora for Burma which should comprise (among other things) a classified account of the different sets of forests, with all the trees in each, and the plants that usually accompanied each: an account of the method and habit of growth of each tree, and an account of the quality of the wood of each, and a special account of all the species likely to prove of economic value."

In his paper[3] on the study of indigenous drugs, Surgeon-Captain (now Major) B. D. Basu, I. M. S. gave an account of the work of scholars in the medical department of the economic aspects of Indian Plants from the establishment of the Asiatic Society of Bengal to 1891. "In the beginning of this century John Fleming contributed a valuable paper on the medical plants of this country. For the first time the scattered information on the subject was collected and placed before the medical profession. * * * Dr. Waring, who edited the Indian Pharmacopoeia,[4] was one of the most painstaking and careful observers of the properties and uses of indigenous drugs. His attention was drawn to the subject when serving out in Burma. The stock of

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1 Roxburgh's *Flora Indica* was published in 1832.

2 The Italics are ours.

3 *Indian Medical Gazette*, August, 1892.

4 Published under the authority of the Secretary of State for India "with the view of bringing to the notice of the profession in India those indigenous drugs which European experience has proved to possess value as medicinal agents, and which may be employed as efficient substitutes for imported articles."

his European medicines having been exhausted, he was in great perplexity and hardly knew what to do. In such a crisis, he turned to the medicinal plants of the country. He found indigenous drugs to answer his purpose as satisfactorily as the costly imported medicines of Europe."

Enough has been said to show that, during the period from the last two decades of the 18th century, the sole aim of botanical researches in India has been

(1) to study scientifically or economically the vegetation of the Indian continent, according to the accepted doctrines of contemporary European thinkers;

(2) to look upon India solely as a vast herbarium supplying specimens for the scholars in the western world; and

(3) to ransack or exploit Indian vegetation in the interest of a foreign industry, commerce and science.

There has been no attempt

(1) to take stock of the existing Hindu literature on the subject of plants, whether *as plants*, or as drugs and useful commodities, or

(2) to maintain and continue the studies of the ancient and mediaeval scholars of India (whether scientific or utilitarian), and develop the intellectual heritage bequeathed by them to posterity. Thus, during the period which has witnessed the growth of Botanical sciences, arts and industries from the insignificant juvenile condition (which was almost on a par with that obtaining among the Hindus) into one of immense magnitude, the genuine Indian Botany, which should have been a continuation and further development of the work of the ancestors of the present race of Indians, is not only where it was, but has been managed to be forgotten and thrown into the limbo of oblivion, from which it is today impossible and even regarded as unnecessary to rescue.

The so-called 'Indian Botany' of the modern times, pioneered by Europeans and collaborated at both by Indian[1] and western scholars, covers really an insignificant niche in the daily-growing museum of the sciences, arts and economic products built up by the people of western countries. And Indians are left in the position of mourning over a national loss: "When we remember how great a part Indian plants have played in contributing to the material and spiritual wealth of India, and in influencing Indian life in its manifold aspects; and when we take into consideration the important place Botany should occupy in every scheme of liberal education, not only as a particular branch of physical science, but also as the most stimulating and refreshing subject of learning, we can estimate the loss both in intellect and material wealth we have been suffering from owing to the neglect of this study. The irony of the situation is that we do not see that the study is the cheapest and

[1] Important Indian names are Uday Chand Dutt, Moodeen Sheriff, K. R. Kirtikar, T. N. Mookerji, N. G. Mookerji, Upendra Nath Kanjilal, Bhandajee, Naraindajee, B. D. Basu, Sakharam Arjun, Lisboa, Ranade, Kanay Lall Dey, Kaviraj Biraja Charan Gupta.

least expensive. To add to the tragedy, we forget that the study is also the most paying; for India is *the* country where worldly careers and lucrative professions can be built up on the products of the vegetable kingdom alone."[1]

In the history of Hindu Botany, then, the whole 19th century – the period of Botany strictly so called in Europe—is a total blank. It has not only given rise to no men who could undertake independent original investigations in the scientific aspects of Plant-life, but has even produced none who could collect, summarise, and adapt or modernise the teachings of their forefathers. The practitioners in the ***Ayurvedic*** system of medicine have but kept up a tolerable second-hand familiarity with the names and uses of the indigenous medicinal plants, through the services of professional herbalists, the Musheras in Central and Upper India,[2] the low caste Maules, Bâgdis, Pods, Chandâls, Kaoros and Karanges in Bengal, and the Chandras, Bhils and Gâmtâs in Bombay.

3. *Summary of Researches in Hindu Botany.*[3]

Under these circumstances, it is not strange that people should entertain doubt regarding the achievements of Hindus in botanical science and the existence of such a thing as the Science of Botany in ancient Hindu literature. The field is altogether untrodden, and awaits the thankless labour of patient investigators, who must be adequately equipped with the double engine of a thorough mastery of modern Botany and a general grasp of the several branches of Hindu literature. And the problem is to carefully glean from the extraneous literary, medical and economic associations, in which the plants have been mentioned by Hindu authors, the abstract ideas and purely scientific concepts, if any, regarding their life-history, morphology, physiology, habit &c.

In the following pages quotations from the works on subjects more or less allied to these topics are being appended, to give an idea of the up-to-date research undertaken.

(*a*) *Gondal.*

The Thakur Sahib of Gondal's *History of Aryan Medical Science,*[4] though not the first work on the subject of Hindu medicine, contains perhaps the first treatment of Hindu Botany. The following is taken from Chapter VII, called Indian Materia Medica. The Ancient Aryans have taken the trouble to examine and study all the herbs that came under their observation, and classified them into groups or *Gaṇas.* Charaka gives fifty groups of ten herbs

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[1] *The Economic Botany of India* by Prof. Bhim Chandra Chatterji (published by the District Council of National Education, Malda, Bengal 1910), pp. 12-13.

[2] See the paper *On the Study of Indigenous Drugs* By Surgeon-Captain (now Major) B. D. Basu, I. M. S., in the *Indian Medical Gazette*, July 1891.

[3] See the history of mineralogical literature for the names of treatises dealing with plants and plant life. Mineralogy, Chemistry and Botany of the Hindus are to be culled mainly from their medical literature. Non-medical literature is also likely to yield genuine scientific notions, if critically studied.

[4] Published by Macmillan & Co., London, 1896. Previous works are those of Drs. Wise and Udoychând Dutt.

each, which, he thinks, "are enough for the purposes of an ordinary physician", though at the same time he adds that "the number of groups can be increased to any extent." Similarly, Susruta has arranged 760 herbs in 37 sets, according to some common properties. Other writers have added to the list, which forms an interesting literature of the materia medica of India. They have also described the proper seasons for gathering the herbs, the period of their growth, when they possess their distinctive properties, the localities from which they should be collected, and the manner of treating them, extracting their active principles, and preserving them. Some of the groups[1] mentioned by Indian writers are given below :—

1. Anga marda praśamana (anti-spasmodic), as Vidarigandhâ (Costus speciosus)

2. Anuloma (Cathartic), as Haritaki (Terminalia chebula)

Agnivesa enumerates no less than 500 classes of medicinal agents, arranged according to their real or supposed virtues in curing diseases A few classes have been selected from this and other sources and noted above.

The chief notable feature in connexion with the nomenclature of the Indian plants is that in several cases their names are descriptive either of their character or of their property. A few instances of names,[2] descriptive of the prominent specific character of the herb, may be given below :—

(*a*) *Brachyramphus sonchifolius* is called Âkhu-karṇî (rat-eared), as the leaves of the plant resemble the ears of a mouse

(*b*) *Acorus calamus* is called Ugra-gandhâ (strong-smelling), because it gives off a very pungent odour.

(*c*) *Clitoria ternatea* is called Go-karṇî (cow-eared), from the supposed resemblance of the seeds to the ears of a cow.

(*d*) *Datura alba* is called Ghantâpuṣpa (bell-flower), from the shape of its flowers.

The following are a few names[3] descriptive of the inherent virtue of the herb :—

(*a*) *Amygdalus communis* is called Vâta-vairî (wind-enemy), as it cures disorders of the wind.

(*b*) *Embelia ribes* is called Krimighna (worm-killer), from its anthelmintic properties.

(*c*) *Ophelia chiretta* is named Jvarântaka (fever-ending), for it is supposed to check fever.

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[1] A list of 75 names has been given by the Thakur Sahib. See pp. 104-110.

[2] A list of 10 names has been given. See pp. 110-11.

[3] A list of 10 names has been given. See pp. 111-113.

(*d*) *Semecarpus anacardium* is known as Aruskara (eschar-causing), because when applied to a living part its juice gives rise to an eschar.

Each successive writer, after a patient and careful investigation, appears to have added new drugs [1] to the existing list. Some of the writers emphatically assert that all curative agents mentioned in their treatises have been thoroughly tested and recommended after a long practical experience. Susruta strongly recommends that physicians should be able to identify the various remedial agents they have to deal with. They should personally go to the jungles, and with the help of shepherds, graziers, ascetics, travellers and others familiar with the forest, gather the herbs when they are in flower, taking care to avoid those injured by insects, or growing in situations containing nests of white ants, or where bodies have been burnt or buried, or from ground in which there is much salt. Narahari Pandit (author of *Râjanighantu* of the 17th century) describes the properties of different kinds of soil, the nature of soils suitable for the cultivation of various medicinal plants, varieties of trees, cereals, oils, vegetables, roots, leaves, flowers and fruits.

(*b*) *Dr. Sen.*

It would appear that the Thakur Sahib did not approach the subject from our standpoint, *viz.*, the study of the strictly scientific ideas of the Hindus regarding plants and plant life. However, no subsequent scholar has interested himself in the subject to any special extent, and this is all that constitutes the foundation of modern researches in ancient Hindu botanical studies.

In his paper on the study of medical science in ancient India,[2] Dr. Gaṇanâth Sen gives the following paragraph on the subject : "In Botany, unfortunately, very scanty records have been left in the writings of Râghava Bhatta and Sârangadhara—an important section of which (*Upavanavinoda*) the humble writer of this paper had the honour of editing and translating some years ago. The informations contained in these books are numerous. Plants have been called *sthâvarajîva*, or fixed animals, and pleasure and pain have been attributed to them. (Compare in this connection the recent discoveries of *Plant Response* by the illustrious Dr. J. C. Bose of Calcutta). Again, plants have been called *sexual* and *a-sexual*, although the details of the sexual phase are missing. Much advance in the practical application of Botany appears to have been made. A regular symptomatology of plants has been described under the name, *Brikṣâyurveda*, and the treatment of certain diseases of plants has been stated. Then, again, an interesting science of finding out *sub-terranean veins of water*,[3] as the geologist calls them, has been briefly described by certain signs, which, says tradition, often come off correct."

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[1] See *Hist. of Ar. med. Sc.* pp. 118-123, for the new drugs introduced by successive writers. The Thakur Sahib's chronology requires to be corrected in the light of recent research, *e.g.*, of Dr. P. C. Ray in the *History of Hindu Chemistry*.

[2] Read at the *Sâhitya Sabhâ* of Calcutta, September, 1906, published by the same society in 1908.

[3] Cf. Chapter LIV of *Brihat Samhitâ*, called *Dagârgalam*.

(*c*) *Prof. Chatterji.*

In the *Economic Botany of India*[1] by Prof. Bhim Chandra Chatterji of the National Council of Education, Bengal, there are a few more details about the achievements of Hindus in the field of botanical science, with remarks as to their relative, historical and comparative values by reference to the progress of the science in Europe. His general remarks on Indian Botany are given below: "This characteristic of Indian culture[2] that it was essentially practical, meant for and adapted to, the thousand and one duties of actual life, has made it always very comprehensive, all-embracing, and all-inclusive. Every Sâstra or Purâṇa or Samhitâ has thus become an Encyclopædia; * * * and, as in the physical, so in the human sciences, we search in vain for the differentiation of knowledge into various branches corresponding to the various aspects of human life. We have no Indian psychology, no Indian ethics, no Indian politics, just as we have no Indian physics, no Indian chemistry, no Indian botany, and so forth, as independent and distinct branches of learning, differentiated from the treatises on universal knowledge.

"* * * European Botany has had a far different history. * * * Not only were the main branches of learning divided among specialists for exclusive study; but each of the various departments of the same branch began to enlist on its behalf the whole time and energy of special sections of the devoted men of science. Add to this the intellectual energy of Europe that became multiplied by being divided and differentiated for the furtherance of national interests and promotion of national glory (owing to the creation of national churches, national states, national literatures, and national schools), and we may form an idea of the enormous labour that has been spent ungrudgingly upon what is to-day a vast Botanical science, which, again, is being split up into independent sciences, distinct from one another.

"But Indian Botany has claims to our recognition on ***absolute*** grounds as well, as having suggested, recognised or discovered some truths about vegetable life which are accepted by modern phytotomy and physiology."

In Internal Morphology we have such descriptions as those of *Tinospora cordifolia* (Guduchi) which is characterised as *Chakrângi, Kundali, Mandali,* &c,—terms referring to the annular rings so prominent in the cross-section or transverse section of the creeper. Metamorphosis of leaves, descriptions of characteristic leaves according to the similarities with the animal world, knowledge

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[1] This brochure was published by the District Council of National Education, Malda, (Bengal) in 1910 and intended to interest people in the forthcoming work on *Indian Medicinal Plants* (a Systematic study, along modern scientific lines, of the most important medicinal plants of India, specially those mentioned in the original Sanskrit works, and also of several other useful plants) with 1300 plates, by Lt. Colonel K. R. Kirtikar, Major B. D. Basu, Prof. Bhimchandra Chatterji and an I. C. S. The work has been in the press for some time and will be published by the Pâṇini Office, Allahabad, in 1915.

[2] Pp. 23-24.

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of adventitious roots &c., may be referred to as evidences of the study of external morphology. In physiology it must be credited to the Hindus that they know of plants as living organisms. Prof. Chatterji quotes from the *Sântiparva*[1] of the Mahâbhârata to prove their acquaintance with the sap-circulation[2], nourishment, power of movement, independent growth and reproduction of plants. "It reflects great credit on those scholars that they conceived the idea of the sexuality of plants and the truth that flowers are the organs of sexual reproduction in higher plants—notions which were first suggested by Camerius towards the close of the 17th century and which have been demonstrated in the 18th and 19th centuries by the studies of Koelrenter, Herbart and Gaertner in hybridisation. To express this sexuality some are even expressly named as such, *e.g.*, *yonipuṣpa* (Cletoria termeata), *lingapuṣpa* (Nerium odorum), meaning respectively the female and the male--and these, together with such terms as *vajrapuṣpa*, menstrual blood of a certain type in Tantra, would lead to the idea that the fact of the flower being the genetive organ of the tree was not unfamiliar to them."

Phosphorescence[3] and exudation[4] of water were probably known. The

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[1] घन्यानामपि वृक्षाणामाकाशोऽस्ति न संशयः ।
तेषां पुष्पफलव्यक्तिर्नित्यं समुपपद्यते ॥
उष्मतो म्लायते पर्णं त्वक् फलं पुष्पमेव च ।
म्लायते शीर्य्यते चापि स्पर्शस्तेनात्र विद्यते ॥
वाय्वग्न्यशनि-निर्घोषैः फलं पुष्पं विशीर्य्यते ।
श्रोत्रेण गृह्यते शब्दस्तस्माच्छृण्वन्ति पादपाः ॥
वल्ली वेष्टयते वृक्षं सर्व्वतश्चैव गच्छति ।
नह्यदृष्टेश्च मार्गोऽस्ति तस्मात् पश्यन्ति पादपाः ॥
पुण्या पुण्यैस्तथा गन्धैर्धूपैश्च विविधैरपि ।
अरोगाः पुष्पिताः सन्ति तस्माज्जिघ्रन्ति पादपाः ॥
पादैः सलिल-पानाच्च व्याधीनाञ्चापि दर्शनात् ।
व्याधि-प्रतिक्रियत्वाच्च विद्यते रसनं द्रुमे ॥
वक्त्रेणोत्पलनालेन यथोर्द्ध्वं जलमाददेत् ।
तथा पवनसंयुक्तः पादैः पिवति पादपः ॥
सुखदुःखयोश्च ग्रहणात् छिन्नस्य च विरोहणात् ।
जीवं पश्यामि वृक्षाणामचैतन्यं न विद्यते ॥ शान्तिपर्व्व, महाभारत ।

[2] Sap-circulation was discovered by Harvey in the 17th century.

[3] वनेचराणां वनितासखानां दरीगृहोत्सङ्गनिषक्तभासः ।
भवन्ति यत्रौषधयो रजन्यामतैलपूराः सुरतप्रदीपाः ॥
तां हंसमालाः शरदीव गङ्गां महौषधिं नक्तमिवात्मभासः ।
स्थिरोपदेशामुपदेशकाले प्रपेदिरे प्राक्तनजन्मविद्याः ॥ Kumârasambhavam.
ज्योतिष्मती तु कटभी सुवर्णलतिकेति च ।
ज्योतिष्कायाऽग्निभासा च लवणोक्ता च दुर्ज्जरा ॥ Dhanwantari-nighantu.
ज्योतिष्मती स्वर्णलताऽनलप्रभा ज्योतिर्लता सा कटभी सुपिङ्गला ।
दीप्ता च मेध्या मतिदा च दुर्जरा सरस्वती स्यादमृताकंसंख्यया ॥ Râjanighantu.

[4] स्याद्रुदन्ती स्रवत्तोया सञ्जीवन्यमृतस्रवा ।
रोमाञ्चिका महामांसी चक्रवती सुधास्रवा Râjanighantu.

knowledge of Heliotropic movement is indicated by such terms as *Âdityakrântâ*, *Suryabhaktâ*, etc., that of Nyctitropic movement by such terms as *Anjalikârikâ* (folded palm), *Namaskârî* (plant which bows down), *Sparsalajjâ* (which feels bashfulness at touch), referring to *Mimosa pudica*. Rejuvenation, separation and multiplication of the individuals which are so essential requisties of reproduction seem also to have been well understood.

Prof. Chatterji traces in the Rig Veda (VIII—47-9 and II, 1-14) the knowledge of Photosynthesis and the action of light and storage of energy on plants. The facts that the sun is the source of energy in the fuel, that it is the setting sun, *i.e.*, that having less refractive rays whence the energy is transformed and kept in the potential form in the fuel, and that this potential energy is manifested as fire or heat, are also known.

The two points, (1) the assimilation of potential energy from the sun and (2) the special suitability of red, orange and yellow rays for the more effective assimilation of plants, *i.e.*, for the storage of energy in the potential form, are definitely suggested in the following :—

अप्स्वग्ने सधिष्टव सौषधीरनुरुध्यसे गर्भे सञ्जायसे पुनः । Rig. viii. 43-9.

त्वे अग्ने विश्वे अमृतासो अद्रुह आसादेवा हविरदन्त्याहुतम् ।
त्वयामर्त्तास: स्वदन्त आसुतिं त्वं गर्भो वीरुधां जज्ञिषे शुचि: ॥ Rig. 2-1-14.

अग्नावोषधिषु च तेजोनिधाय रविरस्तं यातीति आगमः । Mallinâtha.

दिनान्ते निहितं तेजः सवित्रेव हुताशनः । Raghuvamsam.

The first of these is clearly stated in the above by the terms "गर्भे सञ्जायसे पुनः" "त्वं गर्भो वीरुधां" and in the whole of the last texts, which further show that the sun is the source of the energy in the fuel and that it is the setting sun, *i.e.*, having the less refractive rays whence the तेजः or energy is transformed and kept in the potential form, which is manifested as fire or heat.

The *Theory of Evolution* has been described in the following—

(1) तस्मादात्मनः आकाशः सञ्जायत । आकाशात् वायुः वायोरग्निः अग्नेरापः अद्भ्यः पृथिवी, पृथिव्या ओषधयः ओषधिभ्योऽन्नं अन्नात् रेतः रेतात् पुरुषः । Chhândogya Upanișat.

(2) स्थावरं विंशतेर्लक्षं जलजं नवलक्षकं
कूर्म्माश्च नवलक्षञ्च दशलक्षं च पक्षिणः ॥
त्रिंशल्लक्षं पशूनाञ्च चतुर्लक्षं च वानराः ।
ततो मनुष्यतां प्राप्य तत्तत्कर्म्माणि साधयेत् ॥
एतेषु भ्रमणं कृत्वा द्विजत्वमुपजायते ।
सर्व्वयोनिं परित्यज्य ब्रह्मयोनिस्ततोऽभ्यगात् ॥ Brihat Vișņu Purâņa.

In the *Brihat Vișņu Purâņa* an attempt has been made to give the successive stages of development of man to even *Brahmayoni*, the highest form of existence. The *Phylogenetic* and *Ontogenetic* developments are laid down as well as the comparative duration of the stages. The successive number of stages would indeed be visible only after thousands of years of persistent scientific observation of a race of Darwins.

Two things should be further noticed in the text of *Brihat Viṣṇu Purâna.* First, that aquatic life precedes the monkey life, and that the monkey is the progenitor of man. Again, the descent of man from some aquatic animal, although by a remote degree, is grasped with equal acuteness. These ideas are attributed to Darwin; and our countrymen are scarcely aware of the fact that the truths did not fail to strike the savants of ancient India.

Vidyápati has given the order from the highest to successive lower stages:—

किए मानुष पशु पाखी भये जनमिये ।
अथवा कीट पतङ्ग ॥
करम विपाक गतागत पुन पुन ।
मतिरहु तुया पर सङ्ग ॥

That Indian literature should contain such a full account of the evolution of the animal kingdom from the vegetable world, which could be seen only by a Darwin or a Hæckel in such recent times as the 19th century, ought to inspire thoughtful Indians with a noble vanity, and should infuse into our countrymen a spirit of research with a view to finding out the truths in our Sâstras.

"The idea of gradual evolution of higher organisms from lower, was familiar to the Greek philosophers, but a scientific basis was given to this hypothesis in the last century" (Strasburger). Says Prof. Chatterji: "Is it not our duty to demonstrate to the world that the Hindu sages conceived the idea long before it was dreamt of by any other nation, and as such, their names should precede those of any other philosophers? Had the commentators been as acute in explaining these texts, Darwin might have been anticipated in our country long before his name could be heard in the world; or is it that some such commentators lie unnoticed in the dark caves of the Himâlayas?— "Some mute inglorious Milton here my rest!"

In all the above, however, I would only remark that these truths of Botanical Physiology were known to the Hindus simply *as facts*, but no trace has been found as yet regarding their knowledge of the "science" of physiology, *i.e.*, as to *how* these take place in nature; in short, they have observed the facts without caring to 'explain' them or *assign reasons*. And here, again, as in so many other things, we have to continue, by our specialised efforts, the work of our ancestors, and develop them along the proper lines, just as the European scholars of the 17th, 18th and 19th centuries have, by their own labours, improved upon, and added to, the heritage bequeathed by their ancestors of the classic age.

In *Systematic Botany* nothing approaching the keen observation and generalisation of modern times is to be found. One peculiarity has not been traced through a sufficiently large number of plants, and we find only isolated instances of two or three plants classified under one group. Thus, सरल (*Pinus longifolia*) and देवदारु (*Pinus deodara*) are placed in one group. *i.e.*, one is described just after the other in *Madanapâla-Nighantu*, and such instances are found in abundance in all the authors. चिलगोजा or निकोचक (*Pinus gerardine*) could have also been placed in the same group, but. instead, it is named along with अक्षोड़क (*Juglans regia*), etc.

The basis of classification is the property of the plants; *e.g.*, in चन्दनादिवर्ग all sweet-scented things, such as Sandal wood, are mentioned, and in शाकवर्ग all vegetables. In these, however, further subdivisions are made, and here we find some more systematic arrangement, as all कर्कारु, (*Cucurbita papo*), कुष्माण्ड (*Benincasa cerifera*) etc., are grouped together. When one thing has more than one property it is grouped to bring out, as in *Cucurbitaceæ*, the most prominent characteristic, the whole being adjusted to the convenience of a practical man.

खदिर (*Acacia catechu*), रक्तखदिर (*Acacia sundria*), श्वेतखदिर विट्खदिर (*A. farnesiana*) and अरि (*A. pennata*) are all put together in Dhanvantari and in Râja-nighantu in शाल्मलोवर्ग, which is based on the common possession of thorns. Again, many of the plants in *Cucurbitaceæ* have been placed together most possibly for similarity of the fruit. पाषाणभेद, वटपत्री, श्वेतशिला, चतुष्पत्री in *Saxafraga* and निम्ब (*Melia azadirachta*), महानिम्ब (*Melia azadirachta*), कडर्य्य (*Ailanthus excelsa* Roxb), of the *Melianceæ* order, have been placed together for the similarity of the bitterness of the principle in flowers, fruits and leaves. Plants producing bulbs are sometimes placed together. So, in short, any quality or peculiarity has been taken, and plants divided into various artificial groups.

The above will substantiate the view that, under each *varga* or principal group, the members of the same family have been placed together, these so often possessing many properties in common.

The identifying principle accepted by the Indian Botanists depends upon a large number of facts, such as (1) locality, which touches upon Geographical Botany, (2) description of the plant by comparison of its leaves, flowers, roots, fruit, branch, juice, colour, smell and property etc., with some other known things. These things are so given that in most cases all the connotations of one are not found in any other; but very unfortunately, in many cases, the synonyms are highly preplexing indeed.

One instance will be sufficient here to show the difficulty. आखुकर्णी (*Salvania cucullata*) and द्रवन्ती (*Ipomœa reniformis*) are thus described :

Ipomœa reniformis :

द्रवन्ती शम्बरी चित्रा न्यग्रोधा मूषिकाह्वया ।
प्रत्येकश्रेणी वृषा चण्डा पुत्रश्रेण्याखुपर्णिका ॥ Dhanwantari.

द्रवन्ती शाम्बरी चित्रा न्यग्रोधी शतमूलिका ।
प्रत्येकश्रेणी वृषा चण्डा पुत्रश्रेण्याखुकर्णिका ॥
मूषिकाह्वादिका कर्णी प्रतिपर्णी च्छिफा च सा ।
सहस्रमूली विक्रान्ता ज्ञेया स्याश्चतुरेकधा ॥ Râja-nighantu.

Salvania cucullata :

स्यादाखुकर्णी शूपिका द्रवन्ती चित्रा सुकर्ण्युन्दुरुकर्णिका ।
न्यग्रोधिका भूषकनाम कर्णी स्याद्वृरिचकर्णी बहुकर्णिका च ॥
माता भूमिचरी चण्डा शम्बरी बहुपादिका ।
प्रत्येकश्रेणि वृषा चैव पुत्रश्रेण्यद्रिभूह्वया ॥ Râja-nighantu.

The comparison will show the synonyms, and the description of one will be seen to be a mere repetition of the other. The local name is also मूषाकानी for

both. The properties, however, in one are different from those in the other ; fortunately, these are observed in local usages. Hence, the one can be distinguished from the other simply by taking advantage of the properties and nothing else.

Such synonyms recur in many places, and we find the following rule for identification :

नानाभिधेयमथ यन्त्र शिवा समज्ञा
पथ्यादि नाम निगमेषु निवेदितं यत् ।
प्रस्ताववीर्य्यरसयोगवशादमुष्य
बुद्ध्वा विमृश्य भिषजाञ्च धृतिर्विधेया ॥ Rājanighantu.

In many cases, however, the descriptions are quite characteristic, as in हस्ताञ्जली, *e.g., Orchis latifolia*, which is thus described.

हस्तपर्य्यायपूर्व्वस्तु:जोड़िर्वेदैर्वरैः स्मृतः ।
करजोड़िमिति ख्याता रसगन्धादिवश्यकृत् ॥ Rājanighantu.

In this, instead of speaking of any of its peculiarities, the specialist just compares it with the folded palm of the hand which will at once identify it and differentiate it from the rest of the vegetable world.

From terms used in the slokas as synonyms, we get the entire clue to the identification of the plant. A negligence in thoroughly examining these terms has led to disastrous mistakes which have spoilt half the merit of our well-tried system of medicine.

The classifications adopted in Charaka in describing पञ्चाशन्महाकषाया: and in Susruta in सप्तति गद्गणा: are based purely upon the properties of plants; consequently these involve the repetition of one plant in different places. Of the same plant possessing several properties, for instance, यष्टीमधु (*Glycyrrhiza glabra* or *Liquorice* root), mention has been made in connection with

1. जीवनीयानि (medicines which prolong life)
2. सन्धानीयानि (medicines which promote the union of fractured or divided parts.)
3. वर्ण्यानि (medicines which improve the complexion)
4. कण्ठ्यानि (medicines which improve the voice)
5. कण्डुघ्नानि (medicines which cure pruritus)
6. छर्दिं निग्रहणानि (medicines which relieve vomiting)
7. पुरीषविरजनीयानि (medicines which alter the colour of the fæces)
8. मुत्रविरजनीयानि (medicines wich alter the colour of urine)

In each of these groupings there are ten plants mentioned. So there is a *cross division* in many cases.

In Susruta also we find similar classification, according to properties of matter. Other treatises on Medicine also group them according to certain peculiarities, and each grouping is fantastically named after a certain distinguished member of the group. For example, we find in ***Dhanwantari***

Nighantu—गुडूच्यादिवर्गः, शताह्वादिवर्गः, पर्पटादिवर्गः, पिप्पल्यादिवर्गः, शाल्मल्यादिवर्गः, प्रभद्रादिवर्गः, करवीरादिवर्गः, आम्रादिवर्गः, चन्दनादिवर्गः; *in Madanapála Nighantu*— अभयादिवर्गः, शुण्ठ्यादिवर्गः, कर्पूरप्रभृतिसुगन्धिद्रव्यवर्गः, वटादिवर्गः, फलादिवर्गः, शाकवर्गः इक्षुवर्गः, धान्यवर्गः, *in Bhâvaprakâsa*— हरितक्यादिवर्गः, गुडूच्यादिवर्गः, पुष्पवर्गः, वटादिवर्गः, आम्रादिफलवर्गः ।

It would thus appear that the Indian system of classification does not accurately correspond to the classification into Natural Orders which has been founded under the unfluence of the Dogma of the Constancy of Species, during the period from 1750 to 1850, and under that of the study of the Cryptogams in the latter half of the 19th century. It differs widely from the artificial classifications of Brunfels, Fuchs, and other Botanists of Germany and Netherlands who flourished in the 16th century, or of Cisalpino, the Italian Botanist of the same century, who attempted to divide plants into groups by philosophical reflection. While *mainly artificial*, the Indian system may be compared not to that of Linnæus, but of Jussieus, who based it on properties. And for all practical purposes, whatever may be said against its scientific value, a system based on properties was more useful than the systems of the early European Botanists, which, according to Sachs, were too vague and insufficient for identification.

(*d*) *Other Scholars.*

In a recent publication[1] Dr. Sumant B. Mehta, lately personal physician to H. H. the Maharaja Gaekwad of Baroda says : "Susruta divides the vegetable kingdom into Vrikṣa, Gulma, Vanaspati, and Virudha. More information of the science exists in the writings of Râghava Bhatta and Sârangadhara, a section of which, called *Upavanavinoda*, has been translated by Dr. Gananâth Sen of Calcutta. The divisions mentioned above have been worked out into minute subdivisions, but a systematic Botany like the one developed in Europe in modern times did not exist in India. Occasional mention of the habitat of plants, and the description of their foliage exists, but there is no system about it The ancient physicians have indeed written several books on the Materia Medica, and they have laid great stress on the individual characteristics of drugs, which would make the work of identification easy."

In a very short paper[2] on the names of Vedic plants, Mr. Bijaychandra Majumdar has drawn the attention of Bengali readers to the scientific aspect of Hindu Botany, but has touched only the fringe of it.

Appendix A.

(*e*) *Dr. Seal.*

Dr. Brajendranâth Seal has kindly furnished me his notes on scientific concepts of the Hindus regarding plant physiology and classification. His studies are based mainly on non-medical literature and rare commentaries of older authorities. His researches therefore exculde the sources that are generally utilised by stûdents of Hindu botany and medicine. The papers, however,

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[1] The *Ayurvedic System of Medicine* (Navsari, Bombay, 1913), p. 28.

[2] The Bengali monthly, *Bhârati*, for Kârtic 1913.

reached me after the printing of this work had considerably advanced. Hence they are placed in the Appendix along with other papers from the same pen.

4. *Concluding Remarks.*

The foregoing account is a summary of all that has been done in investigating the contributions of the ancient Hindus to the universal science of botany. The account is very meagre, indeed, and indicates that up till now no serious effort has really been made to estimate the botanical value of the Hindu writings on medicine, agriculture, grammar, astronomy, &c. It is high time that the work should be taken up in right earnest as a piece of historical research.

Identification and determination of Indian plants have been rendered tolerably easy. "The principal factors which have contributed to increase our knowledge of indigenous drugs during this century have been the labours of men like O'Shaughnessy, Waring, and Kanny Lall Dey, the holding of Exhibitions, the works of botanists, and forest-officers; and lastly the various scientific societies, notably the Bengal Asiatic Society, the Calcutta Medico-Physical Society, and the Agri-Horticultural Society."[1] The work before Indian Botanists to-day is to equip themselves with a knowledge of Sanskrit and Vernacular literatures and ransack the whole field of Indian literature in order (i) to find out the species of plants named or described therein and (ii) discover in the light of modern knowledge the scientific truths or half-truths they were intended to impart.

There is no reason for despair. The new Teaching Universities with Research Departments that are being promoted throughout the length and breadth of India at important centres, the Oriental Research Institute projected by the Government of India, the College of Science financed by the philanthropic donors of Bengal, Sir Târak Nâth Pâlit and Dr. Râshbehâri Ghosh, the private Academies of Research, and literary as well as educational Councils that have been ushered into being during the last two decades or so, under the impulse of popular upheaval here and there and everywhere in India—all these are expected to be seminaries of independent thought and nurseries of original scholars who would devote themselves to studying the pressing problems of the day together with the antiquities of the country. So that in the near future the national culture and civilisation of India may assert their rightful place in the consciousness of mankind and the history of human progress.

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[1] *The Study of Indigenous Drugs* in the *Indian Medical Gazette*, August, 1892.

CHAPTER VI.

THE DATA OF ANCIENT INDIAN ZOOLOGY.

SECTION I.

The Secular Sciences of the Hindus.

In trying to estimate the knowledge of the Sukra authors regarding the physical and objective world, we have incidentally noticed in the two preceding chapters several important facts in the history of Indian culture :

I. The mineralogical, medical, chemical, and botanical sciences, industries, and arts were wide and deep enough to be drawn upon with advantage by writers of general Sociological treatises like *Sukraniti.*

II. In these physical or "nature studies" lay the *forte* of special schools of Hindu thinkers, who, as masters or commentators[1], were the authors of specialised[2] branches of scientific literature.

III. These schools of Hindu physical science, whether embodied in individual 'masters' or collective organisations like the Pariṣats (*i.e.*, Academies), stood up not simply for the conservation of the statical products of a bygone age, but represented in and through them the dynamical processes of the march of human knowledge. They thus kept moving (i) from epoch to epoch and (ii) from province to province according to the progress of scientific spirit and general culture in Hindusthan, and hence more or less resembled, both in diversity of administration and uniformity of language and literature, the so many scattered centres of culture and learning, called the Universities, which sprang up into existence in the German[3]-speaking world, during the period from the 14th to the

[1] The importance of these commentators in Indian Literature who were not servile copyists or imitators, but enriched the texts commented upon by the addition of their own original investigations as well as the culture of ages, has been critically vindicated by Goldstücker in his *Pâṇini.*

[2] See Major Basu's paper on *Indigenous Medicine* in the Modern Review for March 1914.

[3] See the account of the development of German Universities in Merz's *History of European Thought in the 19th century*, Vol. I, pp. 159-163 ; also the Footnotes. The great cultural uniformity of Hindusthan and the fundamental unity of the Indian Soul as attested by the (i) existence of Sanskrit as the common language for educated and spiritual India and the (ii) predominance and emphasis of the same sets of morals, manners, sentiments and traditions in the everyday life and institutions of the people throughout the length and breadth of India (inspite of the thousand and one barriers to political unity presented by the kaleidoscopic revolutions and boundary-settlements) may be compared with the unifying conditions of German culture, learning and civilisation, inspite of the diversity and disunion of political life that characterise the history of the German peoples till the formation of a nationality and an empire in 1870.

The following facts about the history of German culture have a close parallel in the history of Indian civilisation : "It is not a stationary power, but is continually

18th century. The Indian sciences should not, therefore, be regarded as the finished creations of certain golden eras in Indian history or the characteristic products of one or other of the various races that have peopled India, but are the results (i) of a continuous evolution incorporating the cumulative experience of ages, and (ii) of the conscious or unconscious collaboration of master-minds, systematisers, compilers and commentators belonging to the north, south, east, west and middle of India.

IV. A rigid and unbiassed comparison of the achievements of the Hindus in physical sciences, whether as academic and abstract branches of learning or as aids to practical and utilitarian aspects of life with the contributions of the western thinkers to the same would show that in Europe it is really during the Revolutionary period (1789-1815) or more strictly speaking since 1815[1] that the epoch of the Industrial Revolution and the pre-eminently scientific era which characterise the modern age really begins. And that previous to that, *i.e.*, up to about the beginning of the 19th century, the Hindu as well as the European thinkers were almost on a par. The inductive sciences of the west had not till then displayed the magnificent results which we have been accustomed to associate with them during the latter half of the 19th century. So that it is only the last century's work by which the people of Hindusthan are behind their colleagues in the west.

SECTION 2.

The Alleged Decline of Hindu Intellect.

This aspect of the question requires a little elaborate treatment, since even one of the greatest scientists of our country seems to have been carried away and have supplied the cue for a lament over the "decline of scientific spirit" among the Hindus, and over "this land of intellectual torpor and stagnation."

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on the move from south to north, from west to east, to and fro, exchanging and recruiting its forces, bringing heterogeneous elements into close contact, spreading everywhere the seed of new ideas and discoveries, and preparing new land for still more extended cultivation." "The migration of students as well as eminent professors from one University to another is one of the most important features of German academic life." "There is scarcely a stronger bond of union between the various parts of Germany than that supplied by the Universities, and in no other respect have the barriers that separated state from state been so long broken down." See in this connexion Prof. Radhakumud Mookerji's *Fundamental Geographical Unity of India.* (Longmans Green & Co., 1914).

[1] For an account of the comparatively recent origins of the 'modern' sciences see Weir's *Historical Basis of Modern Europe* (Swan Sonnenschein & Co., London, 1886, pp. 315-469; Mackenzie's *19th century* (Nelson & Sons, 1823), pp. 181-206 309-315, 338, 372-73, 429-432; Price's *Political Economy in England* (Methuen & Co., London, 1900), pp. 5-7; Merz's *History of European Thought in the 19th century* in two Volumes (Blackwood and Sons, London, 1904); Marshall's *Principles of Economics.*

Dr. P. C. Ray concludes his celebrated History of Hindu Chemistry thus :

" The arts being thus relegated to the low castes and the professions made hereditary, a certain degree of fineness, delicacy and deftness in manipulation was no doubt secured, but this was done at a terrible cost. The intellectual portion of the community being thus withdrawn from active participation in the art, the *how* and *why* of phenomena—the co-ordination of cause and effect—were lost sight of. The spirit of inquiry gradually died out among a nation *naturally prone to speculation and metaphysical subtleties*,[1] and India for once bade adieu to experimental and inductive sciences. Among a people ridden by caste and hide-bound by the authorities and injunctions of the Vedas, the Purāṇas and Smritis, and having their intellect thus cramped and paralysed, no Boyle could arise. Her soil was rendered morally unfit for the birth of a Boyle, a Descartes or Newton, and her very name was all but expunged from the map of the Scientific World."

Far be it from our object to detract from the absolute contributions of these western thinkers to the World of Science. It must not be forgotten, however, that the greatest duty the Hindu thinkers were called upon to perform during the period of the so-called torpor and decline of Hindu intellect was the preservation of national existence and the conservation (with necessary adaptation or modification) of the culture of their race against the inroads of aggressive Islam. The greatest achievement of the Hindus and the most marvellous feat of their genius consisted in this that, while other races had to succumb to the steam-roller of 'the Koran, the sword or the tribute' and extinguish all vestiges of their national traditions and institutions, the Hindus alone not only succeeded in withstanding this levelling influence and maintaining their individuality and original race-consciousness, but also in assimilating and utilising the new world-forces in the interest of their own expansion, development and progress.

But for this assimilative capacity, this extraordinary power of displaying and distributing their energies in a *latent* form in the work of social re-construction and synthetic re-adjustments, the whole civilisation of the Hindus would have been swept off the face of the earth and have been driven underground. And instead of a living, moving, growing, and expanding people of to-day the Hindus would perchance have to be excavated and unearthed anew like the fossils of Egyptian, Babylonian and Hellenic culture by future archæolo-

[1] The italics are ours. It is difficult to appreciate the logic of these remarks. If up to the middle of the 17th century, *i.e.*, for a period of over 2,000 years, as Dr. Ray proves by his researches, the so-called caste restrictions and religious prejudices did not stand in the way of scientific work on the part of Hindu scholars and could not prevent them from being at the vanguard of nations, why should these be held responsible for the alleged torpor and demoralisation during the 17th and 18th centuries? More facts require to be unearthed before anything can be proved one way or the other; and a more 'scientific' interpretation of World-Forces that go to make history is also necessary.

gists as merely interesting curios, through which could be dimly deciphered the hieroglyphics of a by-gone age.

The "Doctrine of Substitution" applied by modern economists to the interpretation of the motives and tendencies that underlie human activity in the choice of 'lines of least resistance' and in the investment of resources along various channels in such a way as to derive from each the greatest 'return' with the smallest expenditure, is nothing but a sociological equivalent of, or at any rate, a corollary to, the great Biological Doctrine of the display of vital energy under diverse forms and in varied directions, under the impulse of the 'struggle for existence' and the 'instinct' of self-preservation. The problem before the Hindus during the period referred to by Dr. Ray was pre-eminently and essentially one of social self-preservation, stock-taking and assimilation, re-synthetising of old and new conditions. The struggle was between one socio-religious ideal and another socio-religious ideal, for the Mussalmans did not bring with them any other instruments of culture, ostensibly or as a matter of course. That being the conflict, 'competition' and instinct of self-preservation induced the people of Hindusthan to present not greater and greater original discoveries and inventions in science, industry and philosophy, and an extension of the bounds of human knowledge—[because what they had inherited from their ancestors and developed up till then was already too adequate for what their opponents could possibly display from their armouries and arsenals of cultural equipment, or for what the whole encyclopædia of the Saracenic, Græko-Roman and Teutonic-European learning could exhibit], but mainly a more liberal and elastic interpretation of their socio-religious ideals and institutions, a more philosophic re-laying of the foundations of their social and domestic system, necessitated by the changes in the circumstances of their age.

A really scientific reading of the conditions of life produced in India by the advent of Islam would show, not that the Hindu national mind was totally slain during this period, but that it addressed itself to the more pressing needs of the time; not that the Hindu intellect became 'unscientific,' uncritical, totally abstruse and metaphysical, but that it was solving the most practical and secular problems of the age; not that the Hindu race produced only second-rate, third-rate and eighth-rate intellectuals, only commentators, annotators and copyists, but that it gave rise to some of the most original-brained, synthetic philosophers, scientists and sociologists, who were the Newtons, Leibnitzes and Descarteses of the Hindu national life in re-organising the old and thereby creating the new.

Universal History, if philosophically and biologically interpreted, yields only one fundamental lesson about human progress, *viz.*, that the culture of a race is 'relative' to the conditions of the age. According to this doctrine of the Relativity of Culture, which again is really a corollary to the great Biologico-sociological Doctrine enunciated above, it would be easily admitted that the epoch from Bacon to Linnæus, Humboldt, Whitney and Herbert Spencer has

not probably done for humanity an *iota* of work in any way nobler or greater than what has been achieved in Hindusthan by the band of master-minds from Kavira, Chaitanya, Tukârâma, Nânaka, and other givers of social laws and morals to the days of Râmaprasâda, Râmamohana, Vidyâsâgara and Râmakrişņa Paramahaṃsa.

There is another side of the self-humiliation contained in the assertion of Dr. Ray. He does not seem to have looked upon the achievements of modern Europe with a historic and critical eye, and hence the statement is necessarily partial, one-sided and erroneous.

Even supposing that, about say the middle of the 17th century—the age of Newton—Europe began its career of conquest over the powers of nature and marvelleous achievements in physical or secular sciences and industries, we cannot too often remember

(1) that all these achievements were not altogether of a higher order or greater brilliancy than what the Hindus had achieved and maintained even up to the end of the 18th or beginning of the 19th century, so far as ministration to the 'necessaries, comforts, and decencies' of life is concerned;

(2) that it is only since the epoch of "Industrial Revolution," *i.e.*, the second decade of the 19th century, that the west has really been distancing and eclipsing the people of India in the marvels of theoretical science as well as practical arts;

(3) so that, strictly speaking, the modern spirit, the thought that Europe has actually contributed to the culture of universal humanity, is not more than a century old.

That those sciences and industries, which have marked a complete cleavage between the past and the present, for not having contributed to the making of which the Hindus are fallaciously and unnecessarily condemned as non-practical, un-secular, other-worldy, are only the achievements of yesterday, does not require any laborious historical investigation to be substantiated. In the 13th Edition (revised and partly re-written with additions) of *Discoveries and Inventions*[1] by Routledge, the author says: "The enormous material advantage which this age possesses, the cheapness of production * * * are traceable to the division of labour; to the steam-engine; to increased knowledge of the properties of metals; to the use of power tools * * * Little more than a century ago everything was slowly but imperfectly made by the tedious toil of the working man's hand. * * * Let the young reader who wishes to understand why the present epoch is worthy of admiration as a stage in the progress of mankind, address himself to some intelligent person old enough to remember the century in its teens; let him inquire what wonderful changes in the aspect of things have been comprised within the experience of a single life-time."

It would thus be clear that it is only "a single life-time's work," taking a very narrow and practical and rather non-scientific and unhistorical view,

[1] Published by George Routledge and Sons, London, 1900.

by which modern Europe is in advance of mediæval Europe, or what is the same thing, by which India is behind the western world. A rational interpretation of history would thus be a powerful corrective of the cheap and superficial interpretation of India's past which is inclined to explain one and all of the so-called failures of the Hindus by two catch-words describing their national life and character, *viz.*, caste and religiosity.

Dr. Ray's *History of Hindu Chemistry* is itself one such corrective. Ram Raz's fragmentary *Essay on the Architecture of the Hindus*, published in the earlier years of the 19th century is perhaps the first work on the subject of Hindu achievements of a secular character. The works of Râjendralâl and Udaychând also belong to the same category. Another eye-opener, in our own times, is Prof. Mookerji's *History of Indian Shipping*. And that monumental product of Dr. Seal's massive intellect, the *Mechanical, Chemical, and Physical Theories of the Hindus*, is also most emphatically calculated to give the lie to the alleged inferiority of the Hindu race in secular[1] and scientific achievements.

SECTION 3.

The Zoological Lore of the Hindus.

The remarks in section 1 indicate, in the first place, the position of Natural History and Science in such sociological treatises as *Niti Sâstras*, and in the second place, at once the achievements and limitations of the Hindus in investigations regarding the facts and phenomena of the physical world. The Zoological Data in the *Sukraniti* also point to the same conclusions.

(*a*) *A brief survey of Zoology in Europe.*

Like metals, jewels and plants, animals and animal-life also have been the subjects of copious literature in India. For, since the earliest times, Indian Fauna have played an important part in the socio-economic and socio-religious as well as political spheres of Hindu life.

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[1] Recently, Mr. K. P. Jayaswal, in reviewing Dr. Schoff's *Periplus of the Erythraean*
Sea for the *Modern Review*, has entered another protest thus :—
"Mr. Schoff has quoted at p. 187 the oft-quoted lines of Matthew Arnold that India
let the legions thunder past and she plunged in thought again. The lines have really con-
verted history into a vast 'Mississippi of falsehood.' They ought not to find room in any
serious treatise. Hindu history at every step gives a lie to the allegation. The very fact
of the Greek invasion, on which Mr. Schoff has quoted the lines, instead of being forgotten,
was remembered as late as the 5th century A. C., when the defeat of Seleucus was repeated
on the stage at Pâtaliputra. The poet wanted the history of Chandragupta, the Maurya,
to be re-enacted by Chandragupta the Gupta. Mr. Schoff must be aware of the inscriptions
of the so-called Andhras and the Guptas which proudly celebrate conquests over 'the
legions.' Medhâtithi, writing after the defeat of the Huns, defined India as a country
where 'the legions' could not get a footing even after repeated attempts. The victory of
Sâtakarni II over Nahapâna is still remembered by hundreds of millions of Hindus who hear
and repeat the historical romance of the Vikramâditya, the Destroyer of the Sakas."

Up to the 18th century the progress of Zoology in India is almost parallel with the course it has had in Europe during the "legendary" stage and the "age of collectors and travellers." Indian literature, if minutely studied in the light of modern theories, would furnish some of the earlier among the following landmarks in the history of Zoology obtained from the records of European research :

"Anatomy and the study of animal mechanism, animal physics and animal chemistry, all of which form part of a true Zoology, were excluded from the usual definition of the word; * * * and, whilst the Zoologist was thus deprived of the means of anatomical and physiological study, * * * the demands of medicine for a knowledge of the structure of the human animal brought into existence a separate and special study of human anatomy and physiology.

"From these special studies of human structure the knowledge of the anatomy of animals has proceeded. * * * Thus comparative anatomy came into existence as a branch of inquiry apart from Zoology; and it was only in the latter part of the 19th century that the word 'Zoology,' applied to a knowledge of animals which expressly excludes the consideration of their internal structure, was rejected.

"Scientific Zoology really started in the 16th century with the awakening of the new spirit of observation and exploration. * * * The active search for knowledge by means of observation and experiment found its natural home in the universities. Owing to the connexion of medicine with these seats of learning it was natural that the study of the structure and functions of the human body and of the animals nearest to men should take root there. * * * The influence of the great academies of the 17th century was precisely to effect that bringing together of the museum-men and the physicians or anatomists which was needed for further development. * * * It was not until the 19th century that the Microscope (constructed by a Dutch naturalist in 1683) was perfected as an instrument and accomplished for Zoology its final and most important service. * * * It was reserved for Charles Darwin in 1859 to place the whole theory of organic evolution on a new footing."[1]

The brief and not by any means exhaustive survey of Hindu Zoological literature that is given here to indicate lines of research in this field would suggest that, with the exception of Plasmology or "the study of the ultimate corpuscles of living matter, their structure, development and properties, by the aid of the microscope—exemplified by Malphighi, Hook, Schwann and Kowalewsky," almost all the other "currents of thought and mental preoccupation which have been historically manifested in western Europe in the gradual evolution of what is to-day the great river of Zoological doctrine" have had their more or less perfect embodiments in the history of Hindu thought also. Thus, it will be easy to cull from Indian literature, Sanskrit, Prākrit and vernacular, casual references to, as well as specialised treatises on, ani-

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1 *Encyclopædia Britannica* (11th Edition), Vol. 28, pp. 1022-1024.

mal-life, which may be grouped under the following branches of Zoological study detailed by Sir Edwin Ray Lankester in the latest edition of the *Encyclopædia Britannica* :

(1) Morphography—the work of the collector and systematist exemplified by Linnæus and his predecessors, by Cuvier, Agassiz, Hæckel.

(2) Bionomics, lore of the farmer, gardener, sportsman, and field-naturalist, including thremmatology or the science of breeding, and the allied teleology or science of organic adaptations : exemplified by the patriarch Jacob, the poet Virgil, Sprengel, Kirby and Spence, Wallace and Darwin.

(3) Zoo-dynamics, Zoo-physics, Zoo-chemistry—the pursuit of the learned physician,—anatomy and physiology : exemplified by Harvey, Haller, Hunter, Johann Muller.

(4) Philosophical Zoology—general conceptions with regard to the relations of living things (especially animals), to the Universe, to man, and to the Creator, their origin and significance: exemplified in the writings of the philosophers of classical antiquity, and of Linnæus, Gœthe, Lamarck, Cuvier, Lyell, H. Spencer, and Darwin.

(*b*) *Vedic Fauna.*

The Zoological lore of the Vedic age is not very copious, but gives an adequate picture of the attempts of the people to make themselves acquainted with the various phases of animal-life which came across them.

"The ploughmen sang merrily to the steers (R. V. viii, 20, 19), while ploughing. * * * They kept away birds from robbing them of the growing corn by uttering loud cries (R. V. x 68, 1). * * * The enemies of the agriculturist were rodents, insects and demons which were exorcised by means of spells (A. V. vi 50). A great number of them are named, but cannot be identified. * * Cattle-rearing followed as subsidiary to agriculture. Cowherds took cows out to pasture daily (R. V. x 19, 4, 5). * * On return from pasture the cows were kept in stalls (*gotra*, R. V, ii ; 23, 8, *vraja* A. V. iii ; 11 5, *gostha* iv ; 21, 1), and water troughs were provided for them in various places. * * Draught-oxen were castrated. * * * They reared also goat and sheep. Fat rams for cooking (R. V. x 27, 17) and the ewes of Gandhara, famous for their wool (R. V. i 126, 7), are referred to. Dogs guarded cattle and houses and barked at human thieves (R. V. vii 55, 3), at wolves worrying sheep (A.V. V, 8 4 ; vi 37), and tigers which plague the men rich in kine (A. V. iv 36, 6).[1]

The animal foes of man were roaring lions (R. V. ix 64, 8), wild elephants 'eating forests' (R. V. i 64, 7), tigers, wolves and hyenas (A. V. xii 1, 49) as well as snakes,[2] metaphorically called "ropes with teeth" (A. V. iv, 3, 2), 'brandishing as it were a club' (A. V. i 27, 2); more than twelve species of snakes

[1] Iyongar's *Life in Ancient India*, pp. 23-27.

[2] See also *Atharva Veda*, x 4.

are named in the Atharva Veda Samhitâ as creeping amidst grasses of which five species are named in R. V. i 191, 3. There was also the sharply-stinging scorpion (A. V. xii, 1 46 ; vii, 56, 6, 8) ; worms of various kinds born in the rainy season (A. V. xii 1, 46) and the sharply-biting mosquito (A. V. vii 56, 3) are also mentioned.[1]

The following extracts are taken from the Atharva Veda:[2]

"Together, together let cattle flow (stream), together horses and together men, together the fatness that is of grain ; I offer with an oblation of confluence."[3] This is meant for safety and increase of kine.

"The eagle discovered thee ; the swine dug thee with his snout : smite the dispute, &c."[4] The object discovered by these animals is the root of a plant that is meant for victory in disputation which, for example, "Indra put on his arm in order to lay low the Asuras."

"Let the falcon lead hither from far the one to be called, living exiled in other's territory."[5] The falcon is thus a guide of the King to be restored.

"He who gives a white-footed sheep[6] commensurate with his world, he ascends unto the firmament, where a tax is not paid by a weak man for a stronger." By this offering of a white-footed sheep one is released from the payment otherwise due to Yama's councillors on admission into the other world. [Commensurate—(1) proportioned in value to the place in the heavenly world that is sought by the giver, (2) analogous with the world of light that is aspired to.]

"Both thy (two) eyes and thy mouth, O tiger,[7] we grind up ; then all thy twenty claws. * * * Ruined are the teeth of the beast ; crushed in also are its ribs." This hymn is against wild beasts and thieves.

"The draft-ox[8] sustains earth and sky ; the draft-ox sustains the wide atmosphere ; the draft-ox sustains the six wide directions ; the draft-ox hath entered into all existence. * * * With his feet treading down debility, with his thighs extracting refreshing drink—with weariness go the draft-ox and the plowman unto sweet drink."

The hymn offers an example of that characteristic Hindu extollation, without any measure or limit, of the immediate object of reverence, which, when applied to a divinity, has led to the setting up of the baseless doctrine of henotheism.

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[1] Iyengar's *Life in Anc. Ind.*, p. 60.

[2] Harvard Oriental Series.

[3] Vol. 7, p. 66.

[4] Vol. 7, p. 67.

[5] Vol. 7, p. 88.

[6] Vol. 7, p. 186. See also the verses accompanying the gift of a bull, and the offering of a goat (Atharva ix 4, 5).

[7] Vol. 7, pp. 148-9.

[8] Vol. 7, pp. 164-166. For the extollation of the cow, see Atharva Veda x 10 ; and of the ox again, ix 7.

"With milk, with ghee, I anoint the goat,[1] the heavenly eagle, milky great; by it may we go to the world of the well-done, ascending the heaven, unto the highest firmament. * * * In the eastern quarter set then the head of the goat; in the southern quarter set his right side. In the western quarter set his rum; in the northern quarter set his other side; in the upward quarter set the goat's backbone; in the fixed quarter set his belly; midway in the atmosphere his middle. Do thou envelop with cooked skin the cooked goat, brought together with all his limbs, all-formed." The verses read as if the goat himself, after cooking whole, were set up in position, the head to the east.

"I have gone about the race of snakes,[2] as the Sun about the sky, as night about living creatures other than the swan; thereby do I ward off thy poison."

The birds of ill omen[3] against which incantations are used in the *Atharva Veda* are such "winged missiles" as the dove, the hawk, the owl. For the success of the horse in a race, we have the following verse: "The quickness, O courser,[4] that is put in thee secret, also that went about committed to the hawk, to the wind—with that strength do thou, O steed, being strong, win the race rescuing in the conflict." We have the terms dog[5] and faicon[6] applied metaphorically to the orbs of the celestial sphere also.

According to Mr. Bal Gangâdhara Tilak, "of the various figures we may make out of the star in the constellation of Orion, *one* should be of an antelope's head."[7]

In the chapter on a picnic in Ancient India, Dr. Râjendralâl Mitra[8] refers to the buffalo-meat and game birds as *piece de resistance*: "In the time of the Rig Veda the meat was cooked with milk, and there is a passage in which Visṇu is described as carrying away the broth made of a hundred buffaloes and a hog (VIII 66, 10). Elsewhere it is said (VI 17, 11): 'For thee, Indra, whom all the Maruts, in concert, magnified Pushana and Visṇu cooked a hundred buffaloes.' * * * In the *Grihya Sutra* of Âswalâyana, partridges (*tittiri*) are recommended as appropriate for infants just beginning to take solid food, and ducks, doves, pigeons, and ortolans were formerly in common use."

(c) *Maurya Fauna.*

Mr. Manomohan Chakravarti has studied the rock-edicts and pillar-edicts of Piyadasi,[9] with special reference to the animal-lore contained therein.

[1] Vol. 7, pp. 169-72.

[2] Vol. 7, p. 289.

[3] Book VI, xxvii—xxix.

[4] Atharva Veda, VI, 92. See also XIX. 25. "Be thou an up-carrier uphill."

[5] *Ibid*, VII, 80.

[6] *Ibid*, VII, 41.

[7] *The Orion* (Bombay, 1893), p. 101.

[8] Indo-Aryans Vol. I, pp. 4, 27-28. See also Beef in Ancient India, pp. 354-382.

[9] See Memoirs of the Asiatic Society of Bengal, Vol. I, 1905-1907, pp. 361-374. See also Law's *Studies in Hindu Polity* and the *Artha Sástra* of Kautilya, for the names of the fauna very familiar in Maurya times (4th--3rd cent. B. C.).

Megasthenes' account of "gold-digging ants" in India has been already referred to. His *Fragments* supplies us with more solid information about Indian Fauna.

The use of horses and elephants for the army has been described by Megasthenes also. We know of this from Strabo (XV i 50-52) and Ælian (His. Animal XVI—10).

The training of horses has been likewise referred to in the *Fragments* of Megasthenes.

The information about elephants is copious in the *Fragments*. We learn from it of the methods of capture, training, medical treatment, &c. (Arrian, XIII, XIV; Ælian XII—44. XIII—71).

Some of the wild Fauna of the 4th century B. C. are to be known from Strabo's account (XV i 47) as well as that of Ælian, Pliny, &c., derived from the *Fragments*.

The generic names of the Inscriptional Fauna are: (i) Jîvâni, (ii) Prâna-sata-sahasrâṇi, (iii) Bhûtânâm (iv) Jâtâni, (v) Pasu-cikicchâ.

The following classes of animals are mentioned in the Rock-Edicts: (i) Dupada-catupadesu pakhi-vâlicalesu, (ii) Catupade, (iii) Macche.

By Edict No. I Asoka, the benevolent Cæsaro-papist of India, forbade the general destruction of life both in his own kitchen and in his empire. Two animals are specified: (1) Peacock (morâ, majurâ, majulâ), (2) Deer (mago, mrugo, mige).

By the Edict No. V the slaughter of the following born beings was prohibited:

(1) Parrot (suku).
(2) Starling (sâlikâ).
(3) Alune (unidentified).
(4) Ruddy goose (cakavâke).
(5) Goose (hamse).
(6) Nandi mukhe (unidentified).
(7) Gelate (unidentified).
(8) The bat (jâtukâ).
(9) White ant (ambâ papilikâ).
(10) Female tortoise (dâdi).
(11) Boneless fish (anaṭhika macche).
(12) Veda veyake (unidentified).
(13) Gamgapupuṭake (unidentified).
(14) Skate fish (samkuja macche).
(15) Tortoise porcupine (kaphaṭa sayake).
(16) Squirrel (pannasase).
(17) Simale (Sansk. *Srîmara*)
(18) Bull (samdake).
(19) Okapinde (godhâs?)

(20) Rhinoceros (alasate).
(21) Pigeon (seta kapote).
(22) Goat (ajake).
(23) Sheep (edake).
(24) Pig (sukali).
(25) Fowl (vadhikukute).
(26) Elephant (nâga-vanasi).
(27) Cow (gone).
(28) Horse (aswasâ lakhane).

(*d*) *The Fauna in Hindu Folk-lore.*

The intimate familiarity of the people of Hindusthan with the topics generally treated in Descriptive Zoology or Natural History is also borne out by the existence of innumerable legends, both secular and religious, with animals playing a prominent part as *dramatis personæ*, and as narrators, or forming the subject matter, which entered into the curriculum of studies in ancient and mediæval India. We have already noticed the indebtedness of Europe to India in this branch of literature in connection with the legends of precious stones and metals.

The following extracts from Fausboll's *Indian Mythology* give a short account of such stories: "India has long been looked upon as the *cradle of fairy tales and legends*, and such is indeed the case, for beside numbers of short folk-stories, such as *Velâla-panchavimsati* (25 Tales by a ghost), *Sukasaptati* (70 Tales by a parrot), *Simhâsana-dwâtrimsati* (32 Tales by Images on Vikramâditya's Throne), and, beside those found spread throughout the Mahâbhârata and Râmâyana and in fact in all Indian literature, we have the following important collection of fables, fairy stories and tales: (1) The *Jâtaka* books concerning the Transmigration of soul from about 477 B.C., (2) the *Panchatantra*-book in 5 chapters by Visnu Sarmâ from about 530 A. D., (3) *Hitopadesâ*,[1] the Benefical Instruction by Nârâyana, (4) *Kathâsaritsâgara*, the Lake of the Legend streams by Somadeva from about 1063, (5) Ksemendra's *Avadâna-kalpalatâ*, (6) *Kathâkosa*, a Treasury of Tales.

"To these must be added from more modern times: (1) Frere: *Old Deccan Days*, or Hindu Fairy Legends; (2) Stokes: *Indian Fairy Tales*; (3) Lal Behari De: *Folk-Tales of Bengal*; (4) Steel and Temple: *Wide Awake Stories, Bombay*; (5) Temple: *The Legends of the Punjab*; (6) Knowles: *Folk Tales of Kashmir*; (7) Swynnerton: *Indian Nights' Entertainment*, or Folk Tales from the upper Indus; and from the latest date many stories communicated in the periodical: Indian Antiquary."

To this second list we have to add at least one which has been appreciated by literary connoisseurs as rivalling the merits of the *Arabian Nights*. This is the *Folk Tales of Hindusthan* by Shaikh Chilli[2] (Panini Office.)

[1] See the discussion of date and authorship in Peterson's Preface to Hitopadesa in Bombay Sanskrit Series No. XXXIII.

[2] *Nom de plume* of Sris Chandra Vasu, the versatile Sanskrit scholar and Hindu philosopher.

The *Hitopadeśa*,[1] which draws considerably upon Buddhist Jātakas and Panchatantra, consists of 42 fables in four chapters, and of these 31 deal with animals. The table of contents in this book of stories gives the following topics of animal lore :—

CHAPTER I.

The acquisition of friends.

Fable I.—The story of the Crow, the Tortoise, the Deer, and the Mouse; Story of the Pigeons.
II.—The Old Traveller and the Tiger.
III.—The Deer, the Jackal, and the Crow.
IV.—The Blind Vulture, the Cat and the Birds.
V.—History of the Mouse Hiraṇyaka.
VI.—The Huntsman, the Deer, the Boar, the Serpent, and the Jackal.
VII.—The Jackal and the Elephant.

CHAPTER II.

The separation of friends.

Fable I.—The Story of the Bull, the two Jackals, and the Lion.
II.—The Ape and the Wedge.
III.—The Thief, the Ass, and the Dog.
IV.—The Lion, the Mouse and the Cat.
V.—The Crow, the Golden Chain, and the Black Serpent.
VI.—The Lion and the Rabbit.
VII.—The Lapwing and the Sea.

CHAPTER III.

War.

Fable I.—The Story of the Geese and the Peacocks.
II.—The Birds and the Monkeys.
III.—The Ass in a Tiger's Skin.
IV.—The Elephants and the Rabbits.
V.—The Goose and the Crow.
VI.—The Quail and the Crow.
VII.—The Blue Jackal.

CHAPTER IV.

Peace.

Fable I.—Continuation of the Story of the Geese and the Peacocks.
II.—The Turtle and the two Geese.
III.—The three Fishes.
IV.—The Cranes and the Weasel.
V.—The Mouse and the Hermit.

[1] Translation by Francis Johnson (Allen & Co., London, 1843). For a comparative study of Jātakas, Panchatantra and Hitopadesa, see Peterson's Edition of Hitopadesa, *Bombay Sanskrit Series*, XXXIII (1887).

VI.—The Crane and the Crab.
VII.—The Brahmana and his Goat.
VIII.—The Camel, the Crow, the Tiger, and the Jackal.
IX.—The Old Serpent and the Frogs
X.—The Brahmana and his Weasel.

The stories in the Jâtakas, Panchatantra, Hitopadesa, and other works introduce us, on the one hand, to the actual manners and morals, political and social ideals and institutions, as well as intellectual condition and educational system of the people of Hindusthan, in ancient and mediæval times. On the other hand, they furnish living proofs of the minute Nature-studies in general, and the sympathetic observation of Zoological phenomena in particular, undertaken by the scholars, *litterateurs* and educators of those days.

The importance of these stories in world's literary history is thus described by Charles Wilkins in the preface to his "Fables and Proverbs from the Sanskrit" (1787), quoted by Peter Peterson in the Bombay Sanskrit Series, XXXIII:—

"* * * These celebrated fables, which, after passing through most of the oriental languages, ancient and modern, with various alterations to accommodate them to the taste and genius of those for whose benefit or amusement they were designed, and under different appellations, at length were introduced to the knowledge of the European world, with a title importing them to have been originally written by Pilpay, or Bidpai, an ancient Brahman. Sir William Jones * * in an elegant discourse delivered by him on the 26th February, 1786, * * expresses his sentiments upon this subject in the following words:—

'Their Nitisâstra or system of Ethics, is yet preserved and the fables of Vishnu Sarma, whom we ridiculously call Pilpay, are the most beautiful, if not the most ancient, collection of apologues in the world. They were first translated from the Sanskrit (into Persian) in the sixth century by the chief physician and afterwards the Vizier of the great Naushirwan and are extant under various names[1] in more than twenty languages."

(*e*) *The Sacred Fauna.*

The consecration of animals to gods and goddesses as well as the deification of Fauna are two important features of Hindu religious system. These have left their mark on the literature, sculpture and architecture of ancient and mediæval India, and point to the copiousness as well as popularity of Zoological lore among the Hindus.

Like the stones such as Sâlagrâma, and plants such as Tulsî, Marmelos ægle, Ficus religiosa, Jonesia asoka, Acacia suma, Calotropis gigantea, &c., the animals famous in Hindu religious history and art are many.

[1] The whole subject has been treated in Max Müller's Essay on the *Migration of Fables.* It has to be noted that both Wilkins and Jones were mistaken in considering *Hitopadesa* to be the original work translated into Persian in the 6th century, while in reality the source-book that has been a literary link between the East and the West for centuries is *Panchatantra.*

Of all animals the cow is the most sacred. It typifies the all-yielding earth. All agricultural labour depends on the ox, for no such animal as the cart-horse exists in India. There is a typical 'cow of plenty,' *Kâmadhenu*, supposed to yield all desired objects, images of which are commonly sold in the bazaars, and bought as objects of reverence; and the letting loose of a bull (*Briṣotsarga*) —properly stamped with the symbol of Śiva—in sacred cities like Benares and Gaya, that it may be tended and reverenced by pious persons, is a highly meritorious act.

Serpents, also, are divine animals; they are emblemical of eternity, and are often associated with the gods, especially Śiva. Moreover, a curious race of serpents, half human, half divine, called Nâgas, is supposed to exist in regions under the earth. They are ruled over by three principal serpents named Śeṣa, Vâsuki, and Takṣaka.

Monkeys, a whole army of which aided Râma in his conquest of Ceylon, are of course amongst the most sacred of animals. They are inviolable and never under any circumstances to be molested.[1]

The insignificant tiny creature, squirrel, whose labours of love in the construction of the famous bridge are believed to have been appreciated by Râma himself, also, belongs to the same category.

In his work on Indian Mythology[2] according to the Mahâbhârata, Mr. Fausboll gives the following account of the nâgas or serpents. "They dwell in the bowels of the earth in Nâgaloka, which is endless, aparyanta, crowded with hundreds of different kinds of palaces, houses, towers and pinnacles, and strewn with wonderful large and small pleasure-grounds. The serpent world is likewise called Pâtâla. They also live in caves, in inaccessible mountainous regions, and are even said to be found in the valleys, in Kurukṣetra, on the banks of the river Ikṣumati, in the Naimiṣa forest on the shores of the Gomati, in numbers on the northern banks of the Ganga and in the Nisadha (mountain districts). * * * They are possessed of great strength, have a big body, are frightful, very quick, very violent. They are provided with tusks full of poison. They are handsome, take many shapes and wear showy ear-rings. * * * Some have 3, others 7, and others again 10 heads, etc."

Hamsas or ganders are the animals sacred to the four-faced god Brahma,[3] whose floral emblem is a lotus; for "his chariot, vimâna, which is as quick as thought, is harnessed with hamsas."

The brother of Aruṇa, the Sun-god's charioteer, is Garuḍa (the king of birds), called also Suparṇa, because of his handsome feathers. The story of his birth is narrated in the Mahâbhârata (I, 1073). He has serpents for food, and is the sign or standard of the god Viṣṇu. From him are descended all serpent-eating birds[4] who worship Viṣṇu as their great protector. The

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[1] Hinduism (1877), by Prof. Monier Williams, pp. 169-170.

[2] London: Luzac & Co., 1903.

[3] Fausboll's Indian Mythology (Luzac), p. 74.

[4] Fausboll's Indian Mythology, pp. 77-80.

serpent called Śeṣa or Ananta is also sacred to Viṣṇu, for it is his couch or bed on which Viṣṇu rests in Yoga sleep.

The animals famous in the Indra-cult are the elephant, the horse and the cow. Indra's beautiful and always victorious elephant, who stands at the entrance to Swarga, is called *Airâvata* and has four tusks. His horse *Uchchaisravas* came forth under the churning of the ocean, and is white with a black tail. His chariot is drawn by 10,000 reddish-yellow horses. Nandini[1] or Kâmadughâ is Indra's 'wishing cow,' who grants all wishes and is the daughter of Dakṣa Prajâpati.

The Varâha or boar is the animal in whose form the god Viṣṇu had to embody himself in order to save the earth from the waters of a deluge which had completely enveloped it. The story of this avatâra or incarnation is thus given in the Mahâbhârata (III, 15826): "He thought of the shape of a boar, which animal loves to play in the water. And when he had given himself a boar's body that could speak and which agreed with the traditions of the Vedas, ten yojanas broad and a hundred yojanas long, resembling a great mountain in shape, shining with sharp tusks, thundering like a mass of clouds, and resembling a dark cloud, then the Lord descended like an offering-boar into the water, drew the earth up with one of his tusks and set it back in its place."

Among the ten incarnations of Viṣṇu adopted by Him on the occasions of cataclysms three are animal forms, *e.g.*, those of the *matsya* or *mina* or Fish, *kurma* or Tortoise and *varâha* or Boar; and a fourth is half-animal, half-human, *e.g.*, man-lion or *Narasimha*. The "horse's head-incarnation called the *aswasiras avatâra* is mentioned in the Mahâbhârata only (XII, 13478) and does not belong to the traditional list of 10 known to the latter-day Hindus. Again, according to the Mahâbhârata[2] "the Matsya-incarnation is referred to Brahmâ, and the Kurma-incarnation has no connection with Viṣṇu."

In any case, there is no doubt that in Hindu mythology the Fauna are important enough to have contributed at least three of the ten important forms for the embodiment of the Divinity in times of sore distress for mankind and creation. We have to notice, further, that Yama, the Death-god, has two four-eyed dogs, that Śiva is clothed in tiger-skins, and has, for his conveyance, a white bull with a huge body, thick neck, broad shoulders, that the goddess Durgâ stands on the lion as vâhana or bearer and overpowers the mahiṣa or buffalo, that the alligator is sacred to the goddess Gangâ, the tortoise to Yamunâ, that the six-faced war-god Kârtika rides on a peacock, that the god of success, Gaṇeśa, has the mouse for his embem, and the owl is sacred to Lakṣmi, the goddess of fortune.

Among the Vedic deities, also, we find the same recruitment of conveyances or emblems or signs from the animal world. Thus Pushan[3] is the "herdsman who drives the cattle with an ox-goad and rides on a goat."

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1 *Ibid*, p. 82-90. The story of Nandini has been popularised in the first two cantos of the immortal *Raghuvamsam* of Kâlidâsa.

2 Fausboll's Indian Mythology, pp. 120-122.

3 Oppert's *Original Inhabitants of India* (Constable & Co., Westminster, 1893), p. 276.

(*f*) *The Fauna in Hindu Art.*

Indian art also bears impress of the animal lore of the Hindus. This is natural, since the fauna, being important elements in Hindu religion, cannot but influence the art and literature that have always been associated with it. Architecture, sculpture and painting have in all ages and climes been hand-maids to mythology. The history of Hindu art is no exception to this. Furthermore. we have to notice that art and literature have had their careers independent of religion also, both in the East and West, embodying the thousand and one feelings, sentiments, ideals, aspirations, &c., of a non-religious or secular order.[1] Indian Fauna and animal-lore have left their deep marks on both the religious and secular branches of Indian art; and this is another testimony to the Hindus having cultivated their powers of observation with reference to Natural History.

We have seen that mammals, aves, pisces, and reptiles of the Vertebrate Kingdom have all contributed to the mythology of the Hindus. As might be expected from the tendency of the Hindu mind to give concrete shape to all transcendental or spiritual ideas and embody every sentiment in images, all these phyla of the animal world have their specimens in the religious sculpture or plastic art as well as painting of Hindusthan. The animal vâhanas or vehicles and symbols of the gods and goddesses have ever been the handiworks of painters and sculptors,[2] along with their lords, in stone or bronze or other materials as the case may be.

Architecture also testifies to the prevalence of animal motif in Hindu art. In his essay on the architecture of the Hindus[3] Mr. Ram Raz, Judge and Magistrate of Bangalore, says: "In the existing treatises on Hindu Architecture, no mention is made of anything like a substitution of human figures for columns to support the entablature, but the shaft is directed to be adorned with the figures of demons and animals; yet various examples are to be met with in which human figures, as well as representations of animals, are employed in bold relief in the sides of pillars in temples and porticoes, but by no means like those found in Egyptian architecture. The antiquity of this invention in India is not determined."

The following are the remarks of Dr. Mitra[4] on the representation of animal figures in Orissan Sculpture: "The Uriyas did not prove unequal to the task. They made considerable progress in it, and displayed much tact and

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[1] Mr. Vincent Smith, however, commences his monumental work on the history of Indian art with the hypothesis that "Indian art is the slave of religious tradition," though the innumerable specimens of sculpture and painting described and illustrated by him as well as other art-historians and art-critics bring out the secular aspects in no uncertain light and give the direct lie to the statement.

[2] See Fergusson's *History of Indian Architecture*, Havell's *Indian Sculpture and Painting* and *Indian Architecture*, Vincent Smith's *History of Fine Art in India and Ceylon*.

[3] Published for the Royal Asiatic Society of Great Britain and Ireland in 1834.

[4] Indo-Aryans, Vol. I, pp. 00-101.

ingenuity. In my work on Orissa reference has already been made to their life-like pictures of monkeys, and the success with which sensuous passions have been shown in them. The elephant has also been carved and chiselled with great skill. The horse at the southern gate of the Konârak porch is remarkably well-proportioned, and representations of rats, parrots, geese, goslings, deer and other animals shown in the illustration annexed to my work on Orissa will be generally acknowledged to be pretty close imitations of nature. A colossal bull in the enclosure of the Great Tower is also worthy of note as a specimen of well-finished animal carving. The lion among animals is, however, invariably ill-carved. It has everywhere a conventional, unnatural half-dog half-wolf look about it.

"* * It is generally represented as trampling on an elephant about one-half to one-sixth of its size, crouching under its foreleg. Looking at groups like these, and the marked disparity in the size of the two animals, I am disposed to think that the lion had become extinct in Orissa when the sculptures were made, and the artists had to depend upon tradition and their imagination to produce its likeness. This inference receives some support from the fact of the lions in the Udayagiri bas-reliefs being much better-shaped; and they, it is to be presumed, were delineated when the animal was common in the country. * * Winged bulls and lions are unknown in Orissa."

Animal-life has been portrayed and perpetuated in and through the medium of other forms of Hindu art also, *e.g.*, industrial arts, handicrafts, etc., that minister to the purposes of commerce or domestic life. Such animal figures are those to be met with as decorative or ornamental devices on textile and silken fabrics, carpets, ivory carving, metallic bas-reliefs, earthen, wooden, and stone vessels, &c. In his paper on the *Religious Element in the Arts and Crafts of India* in the Modern Review for March, 1913, Prof. Radhakamal Mookerji gives a detailed account of some of these 'motives': "Among birds the most frequent are the peacock and the paroquet represented in wood-carving as well as in textiles. In the textiles the birds are placed usually head and tail in the vertical bands and in the transverse ones with each alternate bird looking over its shoulder." According to *Yukti-kalpataru*, "the prows of ships admit of a great variety of fanciful shapes or forms: these comprise the heads of lion, buffalo, serpent, elephant, tiger, birds such as the duck, pea-hen or parrot, the frog."

The following extract from Vincent Smith's[1] *History of Fine Art in India and Ceylon* gives a general account of 'animal motives' in Hindu Sculptures and Painting: "The Indian treatment of indigenous animals in both sculpture and painting is as original and artistic as that of plant motives."

"You have only," Sir George Watt writes, "to look at the plants and animals employed in the most ancient designs to feel the strong Indian current

[1] Chapter XI, p. 388. See also the illustration of "antelope frieze" on p. 192, 'Colossal horses' on p. 105, Elephant colossus on p. 106.

of thought there conventionalised, which must have involved centuries of evolution. The treatment of the elephant, monkey and serpent is Indian, and in no way Greek. No Greeks (as few Englishmen to-day) could give the life touches of those animals seen on all the oldest sculptures and frescoes."

"These observations are perfectly true, and in all discussions of the foreign elements in Indian art we must remember that in certain respects Indian artists were not only free from obligation to the Greeks but actually superior to them. The illustrations in the work bear abundant testimony to the Indian power of delineating indigenous living forms, both vegetable and animal. The Gandhara treatment of the elephant is inferior to that of the same subject by the artists of the interior, who were more familiar with the wonderful beast, which is not easy to model or draw well."

Mr. Vincent Smith's monumental work furnishes several pictures of animal-life in Hindu art. We mention here the tortoise sacred to the goddess Yamunâ. There are two[1] pieces of exquisite workmanship upon this subject which have been admired by connoisseurs. "The unsurpassed skill of the Hindu lapidaries in working the most refractory stones is best exemplified by the great jade (or ? jadeite) tortoise, found many years ago in the bank of the Jumna near Allahabad. * * * Mr. King observes that 'for fidelity to nature and exquisite finish it is worthy of the ancient Greeks.' Again, the tortoise in ivory, produced about 1830 by Gobind Ratan of Nayagarh in Orissa, is described by Sir George Watt as a "wonderful creation," which raises the artist who produced it to a position of "equality with the ivory carvers of Europe, Japan or China."

The 'Rider motive'[2] is thus described by Mr. Smith: "At Amaravati and in Gandhara a favourite subject is the departure of Gautama Buddha as Prince Siddhârtha from Kapilavastu on horseback. Generally the horse is shown in profile, but occasionally is represented as emerging from a gateway, and facing the spectator, fore-shortened."

Specimens from the earliest Hindu Paintings in which animal-life has been perpetuated have been also described and illustrated by Vincent Smith. The oldest painting found in the Jogimara cave of the Ramgarh Hill in Orissa belonging probably to 2nd cent. B. C., presents before us elephants, and a chariot drawn by horses. Among the infinite subjects and decorative designs in the Ajanta Paintings (5th—7th cent. A.D. ?) in which "fancy is given full play, simplest objects of nature being pressed into the artists' service," we find panels "with animals combined with lotus, drawn with remarkable fidelity and action, as the elephant, humped bull, and the monkey; parrots, geese, and conventional birds, singly and in pairs, with foliated crests, and tails convoluted like heraldic lambrequins, showing the upper and under surface of the ornament."

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[1] See the illustrations on pp. 357 and 373 of *Smith's Hist. of Fine Art.*

[2] *Ibid*, p. 382.

The picture of fighting bulls is one of considerable interest not only as displaying the artists' command over the manifestations of life, but also as supplying a convention and motive in Indian art-history. The following is the note of Mr. Smith on the one in Ajanta Paintings: "Its treatment proves the artists' knowledge of animal form and his power of expressing vigorous action[1]. The same subject, with variations of detail, is treated in a sculpture at the ancient cave of Bhâjâ, dating from about the beginning of the Christian era, and again in a sixteenth century painting at Akbar's Capital, Fatehpur Sikri."

Three notable paintings have elicited special admiration of Mrs. Herringham:[2] "They are (1) a hunt of lions and black buck, (2) a hunt of elephants, (3) an elephant salaaming in a king's court. These pictures are composed in a light and shade scheme which can scarcely be paralleled in Italy before the 17th century. The whole posing and grouping is curiously national and modern, the drawing easy, light and stately, and the painting suggestively laid in with solid brush strokes—in the flesh, not unlike some examples of modern French painting. The animals—horses, elephants, dogs and black buck—are extremely well drawn."

Two colossal horses at Konârak in Orissa have called forth the following remark of Havell which is considered by Vincent Smith[3] as hyperbolical: "Here Indian sculptors have shown that they can express with as much fire and passion as the greatest European art the pride of victory and the glory of triumphant warfare; for not even the Homeric grandeur of the Elgin marbles surpasses the magnificence of movement and modelling of the Indian Achilles, and the superbly monumental horse and its massive strength and vigour are not unworthy of comparison with Verrochio's famous master-piece at Venice."

The "plunging horse"[4] in the famous choultry at Madura is of interest as being both a fine piece of work in bronze and also a miniature reproduction of a characteristic type of South Indian sculpture in stone.

The fish-motif in Hindu art has been thus described by Havell in *Indian Architecture*:[5] "When used to represent the aura in a sculptured or painted figure of Buddha, the lotus leaf was generally associated with the *makara* (alligator ?), a kind of fish dragon, the fish being an emblem of Kâma, the God of Love and of fertility. The fish was also a sign of good luck, for in the Indian legend of creation it was a fish that saved Manu, the progenitor of the human race, from the flood. This form of aureole, with the makara and lotus leaf combined, is still a tradition with Saivite image-makers in Southern India."

The same writer in his *Ideals of Indian Art*[6] describes the characteristic Hindu feeling of reverence and love of nature, both animate and inanimate,

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[1] See illustration on p. 283.

[2] Quoted by Vincent Smith, pp. 293-94.

[3] Hist. Ind. Fine Art, pp. 195-196.

[4] *Ibid* p. 240.

[5] P. 62.

[6] Pp. 107-112.

as a spontaneous concomitant of the cult of *Bhakti* or the way of Faith (including Hope and Charity), one of the three traditionally recognised paths to salvation in Hindu metaphysics. The Hindu conception of the reciprocity of Man and Nature, the doctrine of the participation of the whole Creation in the joys and sorrows of man, the philosophy of the incompleteness of the one without the other, and the idea that Nature is not a mere background to display man in relief, that even dumb animals have a place in the heaven, are the eternal tenets inspiring every work of the Hindu—in his mythological creation of the abodes of the gods, in his literary master-pieces, and in his finest art-products. Havell illustrates the idea by the story of the faithful dog, in the Mahâbhârata, without which Yudhisthira refused to enter Paradise and care for his own salvation, the participation of all Nature—cows, elephants, lowly bush, gay birds—in the entreaties of the sorrowing citizens of Ayodhyâ on the occasion of Râma's exile, and by the invocation of Sîtâ to the spirit of the lordly peepul tree (*Ficus religiosa*) when the edge of the forest was reached, and also by the compassionate caressing of the faithful horse Kamthaka by Buddha on parting from the "noblest of steeds." We may add also the scene described by Kâlidâsa in canto XIV of Raghuvamsam where Universal Nature—the very deity of Forests—began to wail with Sîtâ when she was deserted near Vâlmiki's forest and given Râma's mandate by Lakṣmaṇa.

The theory of animal *motifs*[1] in Hindu art is thus explained by Havell: "It is not the ignorance and superstition of the primitive savage, but a firmly-rooted belief in the doctrine of re-incarnation and in the immanence of God, which makes the Indian express so reverently and worshipfully his intimate fellowship with all created things. * * * Gautama himself had passed through all forms of life, and in the tree, worm or insect, or in the beast of the field there might still dwell the soul of Buddha that is to come. * * * In the sculptures of Sanchi and Amaravati he (the artist) shows the wild elephant coming to pour libations over the sacred tree under which the Buddha sat, and all the denizens of the forest join with their human fellow-creatures in adoration of Buddha's footprints, his begging bowl or his relic shrines."

The note to plate IV in Dr. Coomâraswâmy's explanatory introduction to his *Selected Examples of Indian Art*[2] deals with a characteristic treatment of animals in Hindu paintings, and *pari passu* presents before us a peculiar tenet of the philosophy of Hindu music. According to the Hindu, modes of music, like all moral, spiritual, intellectual or physical attributes and qualities of man, are the "manifestations and perceptible forms of certain musical beings," the 'Geniuses' called Râgas (male) and Râgiṇis (female).

The tendency of Hindu genius to personify, iconise and tender homage

[1] Read in this connexion "Hindu Ideals—An Appreciation," being the Inaugural Address delivered by Dr. Brajendranath Seal, as King George V Professor of Philosophy in the University of Calcutta.

[2] Essex House Press, Norman Chapel, Broad Campden, Gloucestershire, 1910.

to the creation of religious imagination is manifest in the conception of music, as of *vidyā* or learning, *lakṣmī* or wealth, *sakti* or prowess, and so on. The *Rāgiṇī Tori* is thus described in an old Rajput book on music, with illustrations as well as descriptive verses, called *Rāga-Mālā*, or 'Garland of Rāgas,' a copy of which belongs to Mr. Gaganendranāth Tagore of Calcutta : "Having a shining snow-white form, white as the *kunda* flower, scented with Kashmiri camphor, Tori, embowered in the woods, charmeth the deer with the honeyed sweetness of her vīnā's sound." "The introduction of animals attracted by music," says Coomāraswāmy "is a motif found also in other Rāgiṇī pictures. This orphic motif occurs also in the Lailā-Majnun pictures, where the animals come to hear the songs of Majnun, and in Kriṣṇa pictures, where the cows are represented as rapt by the sound of Kriṣṇa's flute."

Referring to the folk-element[1] in Rajput art, especially Pāhāri Drawings, the same art-historian and art-critic remarks: "In the hill drawings, the influence of the folk appears directly in the constant emphasis laid on pastoral life, not merely in set pictures of Kriṣṇa as the divine cowherd, but in more naive sketches which reflect the everyday life and environment of peasants. Fig. 1. inscribed Sri Kriṣṇa, milkman, affords a good example of this. Another drawing represents a girl looking up at a crow perched on a roof."

The animal motifs in Rajput art have been described with illustration by Coomāraswāmy in his two series of Indian Drawings. Here we meet with cheetah attacking a deer; frisky cows; cow and calf; cow with anklets, bell and plume; lion attacking man and deer; lynx and deer; running elephant; Himalyan sheep; leopards fighting; grasshopper; leopard and deer; four deer; three lions; buffaloes; lion and rhinoceros; running deer; partridge; the divine cowherd; lions.

The following is taken from the *Indian Drawings* Series I (p. 18); "The drawings of animals are amongst the most accomplished and most perfect examples of Indian art of the 17th century. How far the tradition of animal drawing is at all Persian, and how far indigenous it is difficult to say. It is certain that we find very good and vital drawings of animals in the quite purely Hindu work of the Tanjore School, and also that, whereas in Persian paintings wild animals are regarded as creatures to be hunted rather than understood, in Indian work their own specific and even individual character is delineated as affectionately as in the case of the portraits of human beings. The elephant is drawn with special knowledge and skill. * * * The runaway buffalo has all the vitality and vigour which we find in the finest of Japanese animal drawing, while the somewhat demure satisfaction of the tame rhinoceros with bells round its neck is altogether delightful. The rendering of movement in the drawing of four running deer is particularly good; almost equally so is the slow nibbling progress of two Himalayan sheep. * * * The little drawing of a grasshopper shows that the smaller creatures were not forgotten. The drawing of a partridge recalls the beautiful bird-studies of Durer. Some

[1] *Indian Drawings* Series, II, p. 18 (India Society, London, 1912).

of the best animal drawings are those representing the capture of one animal by another, or the set fight between two animals."

(g) *Varâhamihiran Fauna.*

The *Brihat Samhitâ* of the 6th century A.D. is rich in animal-lore—the accounts of what has long been known as Natural History—and devotes several chapters to a description of the features of cows, oxen, dogs, cocks, turtles, goats, horses, and elephants. Chapter LXI begins thus: "All that Parâśarâ told Brihadratha about cows and oxen, I shall briefly state here. I shall, however, treat scientifically of the animals possessing good features."[1]

The following enumeration is taken from Chapter LXXXVI:—"Creatures remarkable for speed, genius, strength, place occupied, merriment, nobleness of mind or good sound are strong when in their own places; the same rule applies to useful animals.

"The cock, the elephant, the peacock, the vanjula, the musk-rat, the duck and the kutapoori are strong in the east. The jackal, the owl, the haritâla pigeon, the crow, the ruddy goose, the bear, the ichneumon, the dove—are strong in the south.

The ram, the swan, the osprey, the partridge, the cat are strong in the west. The crane, the deer, the rat, the antelope, the horse, the cuckoo, the blue jay and hedgehog are strong in the north."

Varâhamihira classifies the Fauna according to habits of life thus:—

(1) The Indian cuckoo, the hog, the sasaghna, the vanjula, the peacock, the sreckarna, the Brahmani duck, the blue jay, the andiraka, the parrot, the crow, the dove, the skylark, the wild cock, the osprey, the vulture, the monkey, and the sparrow are day birds and animals.

(2) The jackal, the pingala, the chippika, the flying fox, the owl and the hare are night birds and animals.

(3) Horses, serpents, camels, leopards, lions, bears, inguanas, wolves, mungoose, deer, dogs, goats, cows, tigers, swans, antelopes, stags, hedgehogs, cuckoos, cats, cranes and pigeons are both day and night animals."

The various cries of animals, of both good and bad omen, have been enumerated in Chapter LXXXVIII.

In describing the methods of interpreting these cries, Varâhamihira adds the note that "birds and animals bear different names in different countries; and hence the animals shall first be identified from their names."[2]

The omens connected with animals, regarding not only cries, but habits, habitats, features, limbs and movements, have been elaborately described in Brihat Samhitâ, and, in fact, form the subject matter of several chapters. Thus

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1 Iyer's *Brihat Samhitâ* Part II, pp. 91-99.

2 *Ibid* Part II, pp. 180-1.

Chapter LXXXIX is devoted to the omens connected with the dog, the next chapter begins with the statement that "all that has been said of the dog applies also to the jackal, but there are a few special points to be noted," and gives the various malefic cries of the jackal. The omens connected with wild animals are described in the 91st chapter, and those connected with the cow, horse and elephant in the next three chapters respectively. The cawing of the crow has a large chapter (XCV) devoted to it. We read that "in the case of people inhabiting eastern countries, the crow on the right side indicates good luck ; but the crowing of the crane indicates prosperity when on the left side. In other countries the case is otherwise. The limits of provinces shall be learnt from a general knowledge of the country.

(*h*) *Ayurvedic Fauna.*

The medical literature furnishes abundant proofs of the intimate acquaintance of the Hindus with all the features of animal organism, internal and external, as well as the principles governing animal life.

The animal kingdom has been utilised for the *Materia Medica* of the Hindus since very early times. The musk and the poisons of *cobra de capello* and of the snake-eating black cobra, are some of the animal-products used in medicine. The properties of the flesh of various kinds of animals have been discussed very elaborately in almost all treaties on Therapeutics.

The following is taken from Gondal's[1] *History of Aryan Medical Science* :

Asthi (bone) of a goat reduced to ashes, and formed into an ointment with other ingredients, is used for curing fistulæ. Cuttlefish bones are also used medicinally.

Danta (tooth) of the elephant is prescribed in leucorrhea.

Dugdha (milk) is nutritive and vitalising. Human milk ** Cow's milk ** Goat's milk ** Sheep's milk ** Elephant's milk ** Ass's milk ** Camel's milk.[2] ** The properties of milk are said to vary according to the colour of the animal and the qualities of the pasture.

Garala (poison) of snakes is used in dropsy.

Meda (fat) of camels and hyenas is considered a valuable local remedy for gouty joints.

Puchchha (feather) of a peacock is said to cure hiccough. It is also believed that snake-poison will not affect one wearing a ring made of copper extracted from peacock's feathers.

Sringa (horn) of a stag has various medicinal uses.

Gondal mentions also the medicinal virtues of cowdung, elephant's fimus, droppings of cocks and goats, conches, cowries, corals, biles of fish and other aquatic creatures, nails, and urine of cows, horses, camels, elephants, goats,

[1] Iyer's *Brihat Samhitā* Part II, pp. 196-97.

[2] Pp. 120-134 (Edition of 1896).

&c., skins of snakes, cob-webs of spiders, leeches, lac, honey, &c., used by the Hindu practitioners of the Ayurveda.

The Hindu Science of Toxicology, again, as one of the eight branches of the Ayurveda, recognised by Charaka, has largely drawn upon Animal-lore. "The treatment of poisons and their antidotes comes under the head of *Kalpa*. Poisons are of two kinds (1) *Sthâvara*, vegetable and mineral poisons; and (2) *Jangama*, animal poisons.[1] * * Jangama poisons include venoms of such animals as insects, scorpions, spiders, lizards, serpents, mad dogs, foxes, jackals, wolves, bears, tigers, &c. * * Both kinds of poisons are used therapeutically by the Hindus."

In his lecture at the *Sâhitya Sabhâ* of Calcutta, Dr. Gananath Sen referred to Hindu Toxicology in the following words: This "contains the treatment

(i) of the crude poisons—vegetable, mineral and animal (including extensive chapters on snake-bites and classification of snakes, &c.), and

(ii) of the microbic poisons, which, it is said, distinctly arise out of the contamination of air, water, and soil, and immunity against which was sought and partly attained.

The practice of appointing physicians skilled in Toxicology to accompany expeditions of large armies and to take charge of the king's kitchen-room was in vogue even at the time of Susruta. So late as in the reign of the kings of Gauḍa we find the relics of the practice in the fact that Chakrapâṇi Datta, the well-known physician and author of Bengal, describes his father as physician in charge of the royal kitchen."

Gondal also describes the indebtedness of Alexander (according to the Greek historian Arrian) to the Hindu Vaidyas in curing cases of snake-bite which defeated his Greek physicians. "In face of the fact that the European Toxicologists are still in search of a specific for snake-poison, the Indian physicians who lived some 2,200 years ago might well be proud of their skill."

It may be incidentally remarked here that it is only during the last two decades or so that snake-poison has been used as an article in western Materia Medica, whereas it has been a recognised drug among the people of Hindusthan from time immemorial. In noticing this superiority of Hindus over Europeans we are reminded of the remark of Dr. Uday Chand Dutt about the diffidence and caution of Yunani practitioners in the internal administration of mineral drugs in which the Hindus had been proficient:[2] "We cannot help admiring the ingenuity and boldness of the Hindu physicians when we find that they were freely and properly using such powerful drugs as arsenic, mercury, iron, &c., while the Musalman Hakims around them, with imperial patronage and the boasted learning of the west," were bold enough only "to use them as few as possible" and consider them to be "dangerous drugs."

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[1] Gondal's Hist. of Ary. Med., pp. 155-156.

[2] Preface to *Materia Medica of Hindus* (Second Edition, 1900), pp. xiv-xv.

According to Charaka, [1] "Animals are divided into four classess (1) Jarâyuja or Mammalia, (2) Andaja or oviparous, (3) Swedaja or those produced from animal excretions, as parasites, etc., and (4) Udbhijja or those produced underground or from vegetable matter, *e.g., indragopa*, a sort of red insect."

The following is taken from Part III of Dutt's *Materia Medica of the Hindus*: "Leeches have been employed by the Hindus from a very remote period. Susruta gives a detailed account of their varieties, habits, mode of application, &c. His account of leeches has been translated in full by Dr. Wise. Pandit Madhusudan Gupta had also furnished a note on the subject for publication in the Bengal Dispensatory. There are twelve varieties of leeches, six of which are venomous and six useful. The venomous leeches are found near putrid fish or animals in foul, stagnant and patrescent water. The good leeches are found in clear and deep pools of water which contain water-lilies. The middle-sized leeches are the best. * * *

"The lac insect (coccas lacca) has been known to the Hindus from a very ancient period. The *Bulea frondosa* is the principal tree in which lac is said to be produced. It is used in colouring silk. * * *

"Eight sorts of honey are described by Susruta; of these varieties, *Mâkṣika* (collected by the common bee), *Bhrâmara* (collected by large black bees), *Kṣaudra* (collected by small bees), and *Pauttika* (collected by small black bees resembling ants) are described by recent writers. * *

"The *Bhâvaprakâsa* describes three kinds of musk, *viz*, Kâmarupa, Nepâla and Kâshmira musk. * * * In describing the properties of the flesh of various animals Sanskrit writers divide them into two classes, *viz., Jangala* or land and *Anupa* or water animals." Land-animals are sub-divided into eight classes, and water-animals into five. Thus we get the following classification:

I.—Jangala or Land Animals:

1. Jangala—living in forest; *e.g.*, deer, antelopes.
2. Vilastha—living in holes; *e.g.*, serpents, lizards, porcupines, &c.
3. Guhâśâya—living in caverns; *e.g.*, tigers, lions, bears, &c.
4. Parṇamriga—living on trees; *e.g.*, monkeys, squirrels.
5. Viṣkira—(birds) which take their food after tearing or scattering it; *e.g.*, peacocks, quails, partridges, &c.
6. Pratuda—(birds) which strike with their beaks; *e.g.*, pigeons, wagtails, cuckoos, &c.
7. Prasaha—birds of prey; *e.g.*, hawk, falcon, &c.
8. Grâmya—domestic; *e.g.*, ox, goat, horse, sheep.

II.—Anupa or Water Animals:

1. Kulechara—grazing in marshes; *e.g.*, buffaloes, yak, rhinoceros.
2. Plava—birds which swim in water; *e.g.*, geese, ducks, cranes, &c.
3. Kosastha—animals enclosed in shells; *e.g.*, conch-shells, bivalve-shells, &c.

[1] *Ibid*, p. 1.

4. Pâdina—footed animals; *e.g.*, tortoise, crocodile, porpoise, &c.

5. Matsya—fishes.

The classification of Fauna adopted in the *Hârita Samhitâ* [1] in the chapters on flesh (XX—XXII), which enumerate and describe several species of animals, is as follows :

I. Chatuṣpada or Quadruped.

1. Ena.
2. Chitrânga.
3. Chhikkara.
4. Rohita.
5. Sukara (or boar)
6. Sasaka or hare.
7. Sallaka.
8. Salyaka.
9. Godha.
10. Muṣaka.

II. Sthalachara or Land Animals.

1. Lavaka.
2. Tittira (partridge).
3. Nîlamayura (peacock),
4. Dwitiya mayura.
5. Kukkuta (jungle fowls).
6. Kapota (pigeon).
7. Chakora.
8. Suka (parrot).
9. Sâri.
10. Krauncha (dove).
11. Kokila (cuckoo).
12. Vivritâkṣa.
13. Grihachataka.

III. Jalachara or Aquatic Animals.

1. Water-Birds.
2. Makara (alligator).
3. Matsya (fish).
4. Kachchhapa (tortoise).
5. Kulira (crab).

Regarding the knowledge of the Hindus about the internal morphology of animal-organism, the following extracts may be cited :—

"The Hindus could set fractures and dislocations in men and beasts. They were perfectly acquainted with the anatomy of the goat, sheep, horse and other animals used in their sacrifices. * * * The constant wars and internecine strifes afforded ample opportunities to the surgeons to distinguish themselves in their professions and acquire considerable dexterity in their work. * *

"In order to acquire dexterity in surgery the preceptors made their pupils practise different operations on various substances. * * Evacuating was practised on the urinary organs of dead animals; * scarification on the fresh hides of animals on which the hair was allowed to remain; venesection was practised on the vessels of dead animals; application of caustics and the actual cautery on pieces of flesh. * * *

"Buddha and his followers [3] would not permit the dissection of animals. They put a stop to animal sacrifice, in which a knowledge of anatomy was indispensable and substituted models of dough."

[1] See the Text edited by Kavirâja Binodlal Sen of Calcutta.

[2] Gondal, pp. 170-180. See Hœrnle's *Studies in Ancient Indian Medicine.*

[3] *Ibid*, pp. 185-186.

(i) *Fauna in Veterinary Literature.*

The very definition of the scope and province of Ayurveda[1] given by Charaka (Sutra-sthâna, Ch. XXX) "covers not only the medical science in its widest aspect including the veterinary science—specified as *Śâlihotra* and sub-divided into *Gajâyurveda* and *Aśwâyurveda*, but also certain phases of Psychology and Ethics on which long philosophical and instructive discourses are found in ancient Ayurvedic works."

The importance and antiquity of veterinary science in the secular literature of the Hindus have been noted by Gondal[2] also: "Hindu medicine was at the acme of its glory in the time of Râmâyana and the Mahâbhârata. To the court of every chief, great or small, was attached a physician. There were Army Surgeons and Court Physicians. * * Veterinary science seems to have been highly cultivated long before that period. Nala, a remote ancestor of the Pândavas, is described as a most accomplished horse-trainer, and as possessing a thorough knowledge of all matters relating to the horse. Nakula, one of the five Pândavas, was an expert in the veterinary science on which he has written several works, his *Aśwachikitsâ* being still extant. The science of treating elephants, bullocks, and other domestic animals, was and is still known in India. * * * Buddha established hospitals for men and beasts all over the country; and the institutes of Pinjrapoles (Animal Hospitals), so peculiar to India, owes its origin to him."

The existence of treatises in Hindu literature, specially addressed to the needs of the animal creation, is the strongest evidence of Zoological studies in ancient and mediæval India. It is quite natural that a veterinary science should have come into being as a differentiated and specialised branch of the general Ayurvedic literature of those days, since agricultural live-stock, draught cattle, cavalry, camel-corps, elephant-corps, &c., were the common features of the domestic, economic and political lives. Some idea of the secular activities and 'nature-studies' of the Hindus will be obtained from an account of their treatises on elephants and horses.

(A) *Pâlakâpya or the Science of Elephants.*

Treatises on elephants are known to be *Gajachikitsâ*,[3] *Gajavaidya*, *Gajâyurveda*, *Hastyâyurveda*, *Hasti-vaidyaka*, &c. The sage Pâlakâpya is by tradition known to be the originator of this science, which is not infrequently named after him. The antiquity of these works is to be inferred from the following note in Prof. Aufrecht's *Catalogus Catalogorum*, Vol. I (1891).[4] "Pâlakâpya is quoted

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1 Lecture delivered by Dr. Gananath Sen on *Medical Science in Ancient India* at the Sâhityâ Sabha of Calcutta in 1906.

2 *Hist. of Ancient Aryan Medicine*, pp. 187-189.

3 A fanciful name is *Gudhaprakâsikâ*. See Aufrecht, I, 140.

4 P. 336.

by Kṣiraswâmin on *Amarakoṣa*, Hemâdri in *Vratakhanda*, *Sârangadharapaddhati* (p. 99),[1] and Mallinâtha."

The volume of literature on the subject would be apparent if we mention the various manuscripts referred to in the above 'alphabetical register[2] of Sanskrit works and authors.' The following account is based on that work.

A work called *Gajachikitsâ*, or 'Treatment of Elephants,' is to be found in the Catalogue of Manuscripts belonging to the late Pandit Radhakrishna of Lahore, who was famous not only for his enlightened views, but also for his great knowledge of Sanskrit lore.

Gajadarpaṇa and *Gajasâstra* are quoted by Hemâdri, and Dinakara respectively on Raghuvamsam. *Hasti-vaidyaka* is a work by Virasena,[3] quoted by Bhattotpala on *Brihajjâtaka*.

Gajaparikṣâ is the name of a work in Oppert's List of Sanskrit MSS. in Private Libraries of Southern India (Vol. II, Madras, 1885). *Gajalakṣaṇa* or 'Characteristics of Elephants,' attributed to Brihaspati, is also to be found in Oppert's List, as well as in the Catalogue of Sanskrit MSS. in the Library of H. H. the Maharaja of Bikaneer compiled by Râjendralâl Mitra,[4] and in the Catalogue of Sanskrit MSS. existing in Oudh compiled by Pandit Deviprasad.[5] A copy of *Gajâyurveda* is to be found in the Supplementary Catalogue of Sanskrit works in the Saraswati Bhandâram Library of H. H. the Maharaja of Mysore, signed by F. Kielhorn. Aufrecht[6] mentions also such names of treatises on elephants as *Gajadâna*, *Gajadânapaddhati*, *Gajanirâjanavidhi*, *Gajasânti*, *Gajârohaṇa-Prayoga*, *Gajâvarta-lakṣaṇa*, to be found in the catalogues of Lahore, Benares, Madras, Tanjore and other places.

Treatises named after Pâlakâpya, the first promulgator of the science, the Charaka of Hastyâyurveda, are to be found in the following catalogues:

(1) Report on the Search for Sanskrit manuscripts in the Bombay Presidency during the year 1880-81 by Kielhorn.

(2) Catalogue of MSS. in the Library of the Benares Sanskrit College—published as a Supplement to the "Pandit" Vol. III—IX (Benares, 1864-74).

(3) Catalogue of Sanskrit Mss. in the Library of H. H. the Mahârâja of Bikaneer—compiled by Dr. Râjendralâl Mitra[7] (Calcutta, 1880).

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1 Aufrecht's analysis of the work in Vol. 27 of the Zeitschrift of the German Oriental Society. Pâlakâpya has been quoted in *Agnipurâṇa* also (Chapter CCLXXVI). See Sivadatta's Preface in Ânandâsrama Edition.

2 First volume published at Leipzic in 1891, Second volume in 1896. Third volume in 1903.

3 Aufrecht, I, p. 765.

4 Published in Calcutta, 1880.

5 Vol. XVI (1883).

6 Vol. I, p. 140.

7 On the merits of Mitra's works Prof. Aufrecht says:

"The copious extracts are very useful, and enable the attentive reader to judge of the contents of a work, even where he is deserted by the English Text. The indefatigable industry of the Editor deserves every kind of commendation."

(4) Catalogue of Sanskrit MSS. in the Private Libraries of the N.-W. Provinces (Allahabad, 1877-86).

(5) A Classified Index to the Sanskrit MSS. in the Palace at Tanjore, by A. C. Burnell (London, 1880).

(6) Detailed Report of operations in search of Sanskrit MSS. in the Bombay Circle (1882-87).

(7) *Suchipustaka* or a list of the MSS. of Fort William, the Asiatic Society in Calcutta, etc. (Calcutta 1838).

The second volume of Aufrecht's monumental *Catalogus Catalogorum* mentions (1) a *Gajaparīkṣā* in Peterson's Fourth Report on the Search for Sanskrit MSS in the Bombay Circle (1894), (2) a *Gajâyurveda* or *Hastyâyurveda*, (3) a *Gajâyurveda* printed at Poona in 1894 by the Ânandâsrama Publishing House, (4) a *Gajendramokṣaṇa*, said to be taken from the Sântiparva of Mahâbhârata (where, however, it is not found) in the Catalogue of Sanskrit MSS. in the Library of H. H. the Maharaja of Ulwar, and also (5) a *Hastyâyurveda* by Pâlakâpya in the last list.

The third volume of Catalogus Catalogorum published in 1903 adds to the above list the following names :—

(1) *Gajavaidya*, with a commentary in Telugu, in the collection of MSS. belonging to the modern Sanskrit literature presented to the Library of the India Office by A. C. Burnell.

(2) *Gajendramokṣaṇa* in Reports on Sanskrit MSS. in Southern India by Hultzsch.

(3) *Hastyâyurveda* by Pâlakâpya in the catalogue of printed books and MSS. in Sanskrit belonging to the Oriental Library of the Asiatic Society of Bengal, compiled by Pandit Kunja Vihari Nyâyabhuṣaṇa, under the supervision of Mahâmahopâdhyâya Haraprasâda Sâstri.

The information contained in these treatises is more or less the same as given in such works of modern times as *Elephants and their Diseases*,[1] by Lieut.-Colonel G. H. Evans, Superintendent, Civil Veterinary Department, Burma, as a cursory glance at the table of contents in the *Hastyâyurveda*[2] published by the Ânandâsrama, Poona, would indicate. This work, attributed to Pâlakâpya Muni, has been edited by Pandit Sivadatta of Jeypore, Professor of Sanskrit in the Government Oriental College, Lahore. In the Sanskrit Preface to his edition Sivadatta says that those branches of Ayurveda concerning elephants, horses and other lower animals which were created by such master-minds as Pâlakâpya, Sâlihotra and others, have become almost extinct and are remembered only by the frequent quotations of latter-day commentators, and that no other Sanskrit treatise on elephants has been printed and published before his.

[1] Published by the Superintendent, Government Printing, Burma, 1910.

[2] No, 26 of the Ânandâsrama Sanskrit Series, Sivadatta's *Pâlakâpya* (1894, Poona).

The work before us is based on four MSS.: two belonging to Jeypore, one to Poona, and one to Calcutta. It is a huge treatise consisting of 727 pages of royal octavo size. It is divided into four books and contains 12,000 ślokas. Book I is divided into 18 chapters, and is called the *Mahârogasthâna;* Book II is divided into 72 chapters and is called *Kṣudrarogasthâna*; Book III called *Salyasthâna* (surgery) is divided into 34 chapters. The last book has 36 chapters.

The work has been composed in the form of a conversation between King Romapâda of Champâ in the Anga territory and his preceptor, the sage Pâlakâpya. The first four chapters of Book I may be taken to be introductory to the whole work. We are told how the king of the Angas wants to have the elephants of the forests tamed for his state, how the animals are brought from the quarters of the country indicated by Louhitya River (Brahmaputra) and placed under the care of Pâlakâpya, the expert in the theoretical as well practical sciences regarding elephants, who condescends to live with the king and be his 'guide, philosopher, friend' in the training and management of elephants. The fourth chapter gives a preliminary survey of the subject matter treated in the whole book.

Besides all topics connected with anatomy,[1] physiology, surgery, food, medicines, diseases, treatment, poisons, &c., the work deals incidentally with the relations between teachers and pupils in Book I, chapter vi, toxicology in Book II, chapter vi, the seasons in Book IV, chapter xv, the leeches in Book IV, chapter xxxiv, the superstitions and religious observances in Book IV, chapters xxxv and xxxvi. In the 4th chapter of Book I there is a distinction[2] drawn between exclusively theoretical and exclusively practical knowledge in *Hastyâyurveda*, and the advice to rulers is that they should appoint such men only, in charge of the elephants, as combine both theoretical knowledge and practical experience, for each alone is quite useless.

(*B*) *Śâlihotra or the Science of Horses.*

Treatises on horses are known to be *aśwachikitsâ*, *aśwasâstra*, *aśwavaidyaka*, *aswâyurveda*,[1] &c. The father of the science of horses and the first promulgator of the veterinary art concerning them is the sage Śâlihotra, after whom also all these treatises are generally named. It has to be remarked that Sâlihotra stands often for all the veterinary sciences of the Hindus, not necessarily those relating to horse-life. In fact Sâlihotrasâstra is divided into two branches (1) Gajasâstra and (2) Aswasâstra.

We have seen that, besides Pâlakâpya, tradition ascribes treatises on elephants to one Virasena and to Brihaspati. Similarly, besides Sâlihotra, Hindu tradition knows of several authors[2] of works on horses, *e.g.*, Nakula,

[1] Book III, Chapters 9, 29.

[2] V. 106-122.

[3] A fanciful name is *Siddhayoga-saṃgraha*. Cf. Aufrecht I, p. 84.

[4] Aufrecht I, pp. 34-35. See the useful Sanskrit Preface to *Aswavaidyaka* by Pandit Umeschandra Gupta Kaviratna, Librarian, Sanskrit College, Calcutta (1887).

Bhojarâja, Jayadatta, Garga Riṣi, Gaṇa, Jayadeva, Sârangadhara, Nalarâja, Vâhâḍa, Dipaṃkara and others.

The antiquity of treatises on horses is to be inferred from the following facts. The work of Jayadatta, called *Aswavaidyaka*, has been quoted in *Sârangadharapaddhati*[1]. Sâlihotra has been quoted by Hemâdri in *Vratakhanda*. The *Hayalilâvati*, also a work on horses, has been quoted by Mallinâthâ.[2]

The volume and importance of Hindu literature on horses would be evident from a glance at the references in the three volumes of *Catalogus Catalogorum*. The first volume[3] mentions :—

(1) *Aswachikitsâ* or *Aswavaidyaka* by Jayadatta in Oppert's lists.

(2) *Aswachikitsâ* or *Aswasâstra* or *Sâlihotrasâstra* by Nakula in notices of Sanskrit MSS. by Râjendralâl Mitra (1871-90), Kielhorn's Catalogue of Sanskrit MSS. in the C. P. (Nagpur, 1874), the Catalogue of Sanskrit MSS. contained in the Private Libraries of Gujrat, Kathiawad, Kach, Sindh and Khandes compiled under the superintendence of Buhler (1871-73, Bombay), Mitra's Bikaner Catalogue, the Catalogue of Pandit Radhakrishna of Lahore, Deviprasada's Oudh Catalogue (vi, xviii, xix), Catalogue of N.-W. P. (V) and Burnell's Tanjore Catalogue.

(3) *Aswadâna* in Oudh and Burnell.

(4) *Aswadânapaddhati* in Radhakrishna and Peterson.

(5) *Aswadânaprayoga* in Burnell.

(6) *Aswadânavidhi* in Oudh.

(7) *Aswalakṣaṇa* in Oppert.

(8) *Aswalilâvati* or *Hayalilâvati* in Oppert II.

(9) *Aswavaidyaka* by Jayadatta in Mitra's Notices (1871-90), and Oudh (VI, XI, XVIII).

(10) *Aswasâstra* in Burnell.

(11) *Aswasâra* in Buhler.

(12) *Aswâyurveda* or *Siddhayogasamgraha* by Gaṇa, son of Durlabha, in Weber's Berlin Catalogue (1853) and in Peterson; by Garga Riṣi in Kielhorn.

(13) Nakula's *Aswachikitsâ* quoted in *Sârangadharapaddhati*.[4]

(14) *Sâlihotra*, "the general name for veterinary art,[5] ascribed to Sâlihotra Muni, for whom Nakula creates a father, Aswaghoṣa (Turangaghoṣa)," in

[1] Aufrecht I, p. 199. *Vide* also Pandit Gupta's Sanskrit Preface, p. 6, where he discusses the identity of Jayadeva.

[2] *Vide* Gupta's Sanskrit Preface, p. 2.

[3] Pp. 34-35, 273, 644.

[4] Aufrecht's analysis of the work in Vol. 27 (1873) of the Zeitschrift of the German Oriental Society, p. 43.

[5] Aufrecht, I, p. 644. *Vide* also Pandit Gupta's Sanskrit Preface to *Aswavaidyaka*.

Benares Catalogue, Radhakrishna, Oppert II, Dr. R. G. Bhandarkar's Report on the Search for Sanskrit MSS. in the Bombay Presidency during the year 1883-1884.

(15) *Sâlihotrasâra* in Radhakrishna.

(16) *Sâlihotronnaya* in Burnell.

(17) *Hayalilâvali* (quoted by Mallinâtha) in Bodleian Sanskrit MSS. (Oxford 1136)

The second volume[1] of Aufrecht mentions

(1) *Aswachikitsâ* by Nakula in Stein.

(2) *Aswadâna* in Oudh (XX, XXI).

(3) *Aswaparîkṣaṇa*, attributed to Nalarâja in Dr. R. G. Bhandarkar's Lists of Sanskrit MSS. in Private Libraries in the Bombay Presidency.

(4) *Aswavaidyaka* by Jayadatta in Peterson.

(5) *Aswâdiguṇâh* in Peterson.

(6) *Aswâyurveda* by Gaṇa.

(7) *Aswâyurveda-sârasangraha* by Vâhâda, son of Vikrama, in Stein.

(8) *Sâlihotra* "veterinary art," ascribed to Muni Sâlihotra in eight *sthânsa*. These are called unnaya, uttara, sariraka, chikitsita, kisorachikitsâ or ṣiṣubhaisajya, uttarottara, siddhisthana and rahasya" in Stein.

(9) *Aswavaidyaka* by Jayadatta in Ulwar

Aufrecht's third volume[2] mentions

(1) *Aswachikitsâ* by Nakula in Burnell's collection presented to India Office, in Dr. R. G. Bhandarkar's Report (1887-91); by Sâlihotra In Bhandarkar.

(2) *Aswavaidyaka* by Jayadatta in Hrishi Kesha Sastri and Siva Chandra Gui's Descriptive Catalogue of Sanskrit MSS. in the Library of Sanskrit College, Calcutta (1898); by Dipamkara, son of Nanakara, grandson of Nidanakara, in Haraparasâda Sâstri's Report (1895-1900).

(3) *Aswâyurveda* by Gaṇa in Haraprasâda Sâstri.

The Hindu treatises on horses treat of almost the same topics as are dealt with in modern works on the subject, *e.g.*, Lieut.-General Sir F. Fitzwygram's *Horses and Stables*,[3] Hayes' *Training and Horse Management in India*,[4] *etc.* The 68 chapters in the *Aswavaidyaka* of Jayadatta and 18 chapters in *Aswachikitsâ* of Nakula, both edited by Pandit Umeschandra Gupta, Librarian, Sanskrit College, Calcutta, for the *Bibliotheca Indica* (1887) deal among other things with their anatomy, the good and bad signs, as indicated by their colour, feathers, &c., age, growth and development, the classification according to mettle, their movements, paces &c., and usefulness as draught-animals or as cavalry &c., embryology, articles of food and nourishment according to seasons, the various ailments and remedies, &c.

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[1] Pp. 7, 153, 188.

[2] P. 8.

[3] Longmans, Green & Co., London, 1911.

[4] Longmans, Green & Co., London, 1906.

The origin of the science of horses is thus described by the editor in the Sanskrit Preface on the evidence of Nakula's treatise. The winged horses of Indra could not be controlled. So Sâlihotra was requested by Indra to lop off their wings. This was done, but the poor animals waited in deputation upon the powerful sage who had brought them to this plight. He was moved and the result was the composition of treatises to heal the wounds of the horses and minister to the needs of their proper development.

APPENDIX B.

(j). Zoological Taxonomy of the Hindus.

See Dr. Seal's notes on the subject in Appendices.

SECTION 4.

The Sukra Fauna.

The authors of the Sukra Cycle were well-read men, their culture was widely varied, and their scholarship adequately deep. The Mineralogical and Botanical data in their work call up before us the large range of their studies, as they unmistakably point to their thorough grasp of the scientific literature of their times. Further, the brief and fragmentary survey of the Zoological lore of the Hindus we have given in the preceding section (i) indicates not only the character of the literary atmosphere in which all Sanskrit works were composed in ancient and mediæval India, but (ii) also suggests to a certain extent the curriculum of nature-studies or the courses of scientific instruction which undoubtedly formed an integral part of the liberal education of the *Brahmachâris* of yore.

The words of Mark Pattison that the appreciation of Milton's poetry is the last test of consummate classical scholarship, apply with equal force to the *Nitisâstra* of Sukrâcharyya, since in this work the authors have summed up the whole encyclopædia of Hindu learning, literary, scientific as well as technical, according to the conception and standard of those ages. *Sukraniti*, from its scope and subject matter, is, as we have already noticed in the chapter on Mineralogy, the embodiment of comprehensive Hindu scholarship, its achievements and limitations, its processes and products, its methodology and contributions—not, however, in the interest of an abstract, academic, intellectual gymnastics, but solely to subserve the practical ends of Hindu socio-economic and socio-political life, in accordance with the actual requirements of some of the epochs of Indian culture-history.

This, however, is unfortunately the main reason why it is difficult to realise the local or epochal characteristics of the work. The analysis of the internal evidences does not carry us very far. The fallacy of *argumentum ex silentio* and the existence of floating or conventional ideas are the eternal agencies that circumscribe the range of 'wide solutions' that may be possibly attempted. Besides, it is not always easy to estimate the value of the findings or data from a work; for (1) they are not sufficiently copious, (2) their comparison and contrast

with standard texts are not in many cases possible, because of the want of many such texts of approved authenticity, and (3) their comparison and contrast with the physical and sociological conditions are, if anything, really vague, indefinite and inconclusive, because of the epitomic and almost universal or uniform character of the Indian world, in both its physical and human aspects.

Thus with regard to the Sukra Fauna, it is not possible to achieve even the tentative character of the results we have arrived at in our treatment of the Botanical data. For our authors have drawn upon the animal world of their country and the Zoological lore of their people in a very general manner. It is not safe to assign a specific character to their references to animal-life, as we have been able to do in the case of their botanical knowledge.

The animal world has been portrayed by the Sukra authors mainly as a store-house of analogies, illustrations, &c. for the truths of the moral world. This treatment is more or less conventional, and, while it indicates a familiarity of the authors with the habits, habitats, &c., of animals, it does not supply us with a positive *terra firma* or a reasonable ground for presuming any geographical limits, and does not seem to prove anything beyond a mere acquaintance with the lore on the subject, through fables or adages.

Besides these illustrative references, there are in Sukranîti some toxicological ideas dealing with the sensitiveness of certain animals to poisons. Now Toxicology is a science as old as the Ayurveda. We meet with it in all medical treatises from Charaka downwards. Pâlakâpya also deals with the subject. The *Arthasâstra* of Kautilya, the work of the 4th century B.C., utilises the current ideas in its chapter on the management of the royal household.

Thirdly, the agricultural live-stock and domestic cattle have been referred to in Sukraniti, but the references are not very exhaustive. Anything like detailed treatment of the animal world is to be met with in the chapter on the Animal-corps of the state. But here, also, we miss, as we should, not only the comprehensive character of *Pâlakâpya* and *Aswavaidyaka*, &c.,—treatises devoted exclusively to elephants and horses,—but also the elaborate details that we expect in handbooks meant for officers of the state. Such an exhaustive account of the military live-stock, however, we get from Kautilya's *Arthasâstra*, which has drawn upon the veterinary literature of the country to a more considerable extent.

Thus the whole subject of cattle, their maintenance, protection, medical treatment &c., treated in the second chapter of Mr. Law's work based on the *Arthasâstra*, is entirely lacking in *Sukraniti*. Similarly, the geographical, technical and other aspects of fauna, wild, domestic, agricultural or military, which are to be met with in Sivadatta's edition of *Hastyâyurveda* and Umeshchandra's edition of treatises on horses by Jayadatta and Nakula, have been treated by Kautilya, but neglected by the Sukra authors. To quote Mr. Law,[1] "As in regard to horses, certain ceremonies were observed to propitiate

[1] P. 58.

unseen agencies for the welfare of elephants. Thus *ârati*, or waving of lights, was performed thrice daily in the rainy season and at periods of conjunction of two seasons. Sacrifices to *Bhûtas* were also performed on new moon and full-moon days, as also to Senâni or Kârtikeya, the god of war." Ceremonies like these have been described in the last two chapters of Pâlakâpya, Book IV.

A reference to the Zoological works in Hindu literature would demonstrate the depth and width of the learning displayed by Kautilya in his compilation of the *Imperial Gazetteer* of Maurya India, and would substantiate the truth contained in the following words with which Mr. Law concludes his account of the Department of Live-stock in Chandragupta's Government: "We have seen the comprehensive character of its scope and work touching the welfare and growth of such important animals as the cow, the horse or the elephant, on which depended, to a great extent, both the economic prosperity and political security of the country."

The paucity of Zoological information supplied by *Sukraniti* would be evident from another consideration also. In the case of the Flora, the enumeration of trees in two lists gave us scope wide enough for the application of the ecological and literary methods in order to find out its *locale.* But the authors have not presented us with any taxonomy of animals, scientific or unscientific, or any register of the fauna to be kept in Zoological gardens or hunting forests, or the like. We do not read in the Sukraniti of any system of classification or enumeration like that we find in the *Artha-sâstra*, for example. The following list of Kautilya, though very poor, does at any rate furnish us with a positive record of the fauna in the Royal Gardens or State Forests of the Empire ruled from Pâtaliputra, the historic city of Eastern India in the post-Buddhistic ages. The animals[1] that were exempted from capture, molestation and slaughter, and maintained in the *Abhaya-vanas*, or 'Forests of safety,' are :—

(1) Birds, deer and other animals living in the forests under state protection, as well as fishes in the ponds therein.

(2) Those birds, fishes, deer, and other animals that do not prey upon life.

(3) Calves, bulls, and milch-cows.

(4) Ocean animals resembling elephant, horse, man, ox, or ass.

(5) Fishes in rivers, lakes and canals.

(6) A few game-birds, specially named as follows: cranes in rivers, lakes and canals, ospreys, sea-eagles, gallinules, swans, flamingoes, &c., Brahmany ducks, pheasants, fork-tailed shrikes, partridges, cuckoos, peacocks, parrots, *Turdus salica* (mainâ).

(7) Those birds and beasts that were regarded as sacred (*e.g.*, those enumerated in Asoka's Rock-Edict V).

[1] Law's *Studies*, pp. 32-33. The protection of birds in agricultural countries is a necessity as worm-eaters. *Cf.* the wretched condition of French agriculture as a result of the indiscriminate destruction of birds.

Even such a list, if we had it in Sukranîti, would not have been sufficient for the purposes of finding out the *locale* of the Fauna and of the authors who described it ; for (i) a study of the Zoological geography[1] of India would indicate that these are more or less uniformly distributed throughout the country, and (ii) the commercial history would show that fauna have been imported to long distances from their native habitats as articles of commerce.

But Sukranîti refers to animals only incidentally as it were; the natural presumption being that the nature-studies in it, as far as the fauna is concerned, are not probably the result of any direct local or personal experience, but are derived from the perusal of works on the subject or the store-house of floating Zoological literature. If, again, personal or local experience be admitted, no conclusive evidence as to the home of the authors can be secured, since the animals may be brought from place to place for purposes of sale.

The existence of camel-corps in the army seems to be a special feature of Sukranîti and might point to the locality where camels abound.[2]

But camels have been important in Indian economic life since at least the days of *Arthasâstra*. Thus, among the duties of the superintendent of pastures[3] in Chandragupta's Empire, was the regulation of the grazing of cattle. "As to the kind of animals that were allowed admission into the grazing grounds, we have information from two passages. The first passage mentions that a herd may be of cows, buffaloes, goats, sheep, asses, camels, horses or mules. The second passage, which appears in a different context, refers to cows, horses, and camels as being the animals which flourish on pastures and are the source of power to the king."

If camels be recognised to be a 'source of power to the king' by the Prime Minister of the first Empire-builder in India, it is not difficult to see that the camel-corps should have been a regular institution in the war-establishment of Hindu kings of any importance. Even if their territory did not include areas specially fit for camel-life, rulers would find no difficulty in importing them as articles of commerce for purposes of conveyance, peaceful or military. It may be observed that, as marketable commodities, animals, though less mobile than metals and precious stones, are more so than flora ; the 'market' for them is therefore wider and more extensive.

As for the habitat of camels, it has to be noted, that they are "nowhere found in a wild state."[4] Again, to quote from Blanford's *Mammalia* in the *Fauna of British India*. "It is unknown in the wild state, and although Bactrian camels have been found wild by Prejvalski and others in the deserts east of Yarkand, there is but little doubt that these wild individuals are descended from tame ancestors."

The result is, that camels are to be seen wherever there are people rich enough to need and have a 'demand' for them. The mention of camels

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[1] Chapter V. *Indian Empire* Vol I, in the *Imperial Gazetteer* of India.

[2] As Prof. Yogeshchandra Ray suggests in a footnote to *Ratnaparikṣâ*.

[3] Law's *Studies*, p. 27.

[4] *Natural History of Indian Mammalia* by Sterndale (Thacker, Spink & Co., Calcutta, 1884), p. 518.

and existence of camel-corps, therefore, do not necessarily point to the natural habitat of these animals, but solely to the power, prosperity and importance of the persons who command them.

Just as in the case of minerals we could not come to any reasonable conclusion as to the locale of the Sukra authors, so also here we have to confess inability to point to any geographical environment which might leave its stamp on the work. We proceed now to give an account of the various species of fauna referred to in Sukranîti.[1]

SECTION 5.

Mammals in Sukraniti.

Reserving for subsequent treatment the agricultural live-stock and animal-corps, we notice here the various orders of fauna treated by the Sukra authors.

(a) *Primates.*

The monkey[2] is one of the animals whose sensitiveness to poison should be availed of in the detection of deleterious and malefic ingredients in the king's food. The test is supplied by the fact that at the very sight of poisoned food, monkeys pass stools.

The Sukra authors have recorded also the tradition of monkeys being followers of the hero of the Râmâyaṇa. "There has never been a virtuous king like Râma, of whom even monkeys[3] accepted service." Again, "Fate was certainly unfavourable to Râvâṇa, when he met with discomfiture from even one monkey[4] on the occasion of *Vanabhanga.*"

(b) *Carnivora.*

There are three families of this order in Sukraniti—Cats, Dogs and Bears.

i. *Felidæ,*

The Felidæ or Family of Cats is represented by (1) the Lion, (2) the Tiger, (3) the Fishing cat.

In *Sukraniti,* the lion is the embodiment of strength[5] and prowess. The authors have illustrated the strength of unity by drawing the analogy of the union of threads. "The unity of opinion possessed by the Many is more powerful than the king. The rope that is made by a combination of many threads is strong enough to drag the lion."

The lion is the king of animals, and hence is used by all Sanskrit authors for comparison with the ruler of men. Lion-cubs are like princes;[6] in the section dealing with the management of princes we are told that "even when well-governed, if they get a slight opening, they forthwith kill the protector, as lion-cubs kill the elephant at the first opportunity."

Lions were tamed[7] in those days. The taming of lions has supplied an

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[1] 1889-91, p. 558.
[2] Sukra IV, vii, 838-39.
[3] Sukra II, 35-37.
[4] Sukra I, 653-57.
[5] Sukra V, 114-15.
[6] Sukra I, 111-13.
[7] Sukra IV, i, 48-49.

illustration in statecraft. "One should bring friends and foes to bay by appropriate methods, just as snakes, elephants and lions are tamed."

The tiger[1] is one of the animals with which the king is advised to sport in the forests, and which is to be used by him for extirpating the undesirable, *i.e.*, seditious or intriguing,[2] relatives in the interest of the state's prosperity.

Tiger-hunting was certainly one of the adventurous feats of both rulers and men; among the general rules of morality we have the advice that one should not go alone to attack snakes, tigers[3] and thieves.

The tiger is known to be inferior in position to the lion. It is also stated that the king should promote the soldiers' strength and valour by organising hunting excursions against tigers[4] and big game.

Thus we read that, just as even the tiger[5] and the elephant cannot govern the lion, the king of beasts, so all the councillors combined are unable to control the king, who acts at his own sweet will.

The tiger is also known to be untamable, hence the advice, "Association with tiger,[6] fire, snake, and other ferocious animals is not good. Even when served, the king and these things can never be friends to any body."

It has to be remarked that Sukra authors know of the lion and the tiger as animals belonging to the same tribe, the Felidæ. In the section on construction of images of gods and their *vâhanas* (vehicles or conveyances or symbols), we have the following rules: "The tiger[7] has the form of a cat, yellow colour, black marks (stripes), huge physique and no manes. The lion has a thin waist, large eye-brows, big eyes, a young appearance, manes, grey colour and black marks. The difference between the lion and the tiger is only in manes and marks, not in appearance." The fact that these animals belong to the same family is known by the proverb common enough in India that the cats are aunts of these animals.

The tiger is one of the animals that have supplied emblems and seals of state. Thus, on the authority of the Tamil classic, *Pattinappâli*, Mr. Aiyangar says in *Ancient India*[8]: "They did not forget in those days to maintain a regular customs establishment, the officials of which piled up the grain and stored up the things that could not immediately be measured and appraised, leaving them in the dockyards carefully sealed with the tiger signet of the king."

The cat[9] is the animal the lustre of whose eyes has supplied the name for the moving rays of a gem, called Vaiduryya. The habits of the fishing cat are well-known to the Sukra authors. In the supplementary chapter dealing with the political morality of rulers, Sukrâchâryya advises the king always to be on the look out for opportunities. "One should wait guardedly like the cat[10] and

[1] Sukra I, 665-66.
[2] Sukra II, 55-56.
[3] Sukra III, 323.
[4] Sukra IV, vii, 830-31.
[5] Sukra IV, iv, 331-35.
[6] Sukra IV, vii, 34-35.
[7] Sukra III, 518-519.
[8] P. 66.
[9] Sukra IV, ii, 92.
[10] Sukra V, 8-9.

the fowler, and by creating confidence extirpate the enemy whose soul has been ruined by vices."

ii. Canidæ.

The Canidæ or the Dog-Family is poorly represented. There are no references to jackals, foxes or wolves. Only the common dog has been mentioned. It stands for a contemptible miserable creature in the following Burns-like ultra-socialistic statement of Sukrâchâryya : "Does not even the dog [1] look like a king when it has ascended a royal conveyance ? Is not the king justly looked upon as a dog by the poets ?"

The idea is that the king does not look magnificent unless he is attended by the retinue of officers and the regal insignia as well as the paraphernalia. The king alone is no more than a dog, *i.e.*, cannot command awe and reverence of the people. Truly,

"The rank is but the guinea's stamp,
The man is the gowd for a'that.
* * * *
You see you birkie, ca'd a lord,
Wha struts, and stares, and a' that ;
Though hundreds worship at his word,
He's but a coof for a'that."

iii. Ursidæ.

The Ursidæ or Bear-Family is likewise not important in Sukranîti. One species has been mentioned and that only once. The timid horses are known to be those that have snake-like tongues and the colour of bears.[2] Evidently the black bears[3] are referred to, which are covered with long coarse hair, inhabit some of the hottest parts of India, are generally very timid and are easily tamed.

(c) Rodentia.

Only one Family of this order has been mentioned in Sukraniti, *e.g.*, Rats and Mice.

The Muridæ or Rat-Family is represented by common rats. Their sensitiveness to poison has been mentioned by the authors as one of the tests for examining the food of the king. At the very sight of poisoned food the rats[4] become excited."

(d) Ungulata.

"To this order belong elephants, horses, rhinoceros, tapirs, oxen, antelopes, goats, sheep, deer, camels, and swine, besides several generic forms not now found in India. Some of these, however,—for instance, a species of giraffe and hippopotamus inhabited the country in past times. All the most valuable domestic animals are ungulates."

From this statement of Blanford it might be naturally expected that the ungulates should be copiously represented in Sukranîti. In fact it is so ; and

[1] Sukra I, 745-16.
[2] Sukra IV, vii, 330.
[3] Indian Empire, Vol. I, Chap. 5, p. 223, in the Imp. Gazet. Series.
[4] Sukra I, 654-57.

whenever there is a general reference to animals or an enumeration of several species, we may take it to imply the ungulates. Reserving the agricultural and military live-stock, *e.g.*, the elephants, horses, camels and bulls for separate treatment, we mention below the various contexts in which the other families of the ungulates have been referred to by the Sukra authors.

i. Capridæ.

The Capridæ or Goat-Family has been well-represented in Sukranîti. Of course the distinction between goats and antelopes cannot be traced in it Among the references to cattle, without any specification, goats are to be understood as belonging to them. And in those passages where one or two animals have been mentioned by name and the others are referred to by an "etc.," goats should certainly be counted.

Some of the officers in the Department of Live-stock in Hindu States are in charge of goats,[1] sheep, cows &c. Only such persons are to be appointed as are skilful in tending and nourishing them and who have love for those animals.

The goat is known to be a very stupid animal. The stupidity of a man, vain through possession of wealth, is thus described: "The man who is proud of his wealth does not know of his own infamy, just as the goat[2] uses his urine to wash his own urine-scented mouth or face."

The comparative prices[3] of sheep, goats and cows are given below:

Ordinary:

She-goat = $\frac{1}{2}$ cow [= $\frac{1}{2}$ silver *pala* (= Rs. 4)].

She-sheep = $\frac{1}{2}$ she-goat = $\frac{1}{4}$ cow [= Rs. 2]

Extraordinary:

Cow = 8 or 10 silver *palas* = Rs. 64 or 80.

She-goat or she-sheep = 1 silver *pala* = Rs. 8.

The Public Finance of Sukrâchâryya recognises goats and other animals as important national resources to be tapped in the interest of the state. The king should realise one-eighth of the increase of goats,[4] and one-sixteenth of the milk of she-goats. The payments are to be in kind, it appears.

ii. Ovidæ.

The Ovidæ or Sheep-Family has received the same treatment in Sukraniti as the Capridæ. We have seen in connexion with goats the rules about the appointment of officers for the management of the royal live-stock. The prices of sheep also have been given above in the comparative statement. The wool[5] derived from the fleece of the sheep is, like silk, an important article of the royal household; and trained men have to be appointed to look after these stuffs.

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[1] Sukra II, 207-8.

[2] Sukra III, 179-180.

[3] Sukra IV, ii, 188-192. The History of Indian Prices will be dealt with in the chapter on the *Data of Ancient Indian Economics.*

[4] Sukra IV, ii, 239-240.

[5] SukraII, 307-308.

The state revenue from sheep is indicated in the following regulation: The king should have one-eighth of the increase of sheep,[1] and one-sixteenth of the milk of the female animals. The rule is thus exactly the same as in the case of goats.

iii. Cervidæ.

The Cervidæ or Deer-Family is celebrated in Indian classical poetry. The elongated eyes of the animal are the touchstone of beauty in visual organs, according to the æsthetic sense of damsels idealisd by Hindu poets. The animal is also appreciated for its gentle and tame disposition, and is the invariable stock-in-trade of authors for describing peaceful hermitages of ascetics and saints. The deer is known to be very fond of music. In Rajput school of painting, the deer is the conventional symbol[2] for one of the tunes or Râgiṇîs, called the *Tori.* Sukrâchâryya, in describing the *Viṣayas* or things of enjoyment which overpower the character of human beings, refers to the effects of delightful sound even upon lower creatures: "The deer,[3] which is innocent, feeds upon grass and blades and can roam far and wide, seeks death attracted by the music of the tempter." This fondness of the deer for music has been again referred to in connexion with statecraft. "One should always do good of those whom one intends to ruin. The fowler sings sweet in order to entice and kill the deer."[4]

The Department of Live-stock should make provision for stabling the animals. The following rule about deer applies equally to goats, sheep, &c.: "Houses should be built towards the west for cows, deer,[5] camels, elephants and other animals." The rule for the appointment of men in charge of animals is the same in all cases. We are told that each species should have a separate staff of officers: "The king should appoint separately the heads of elephants, horses, chariots, infantry, cattle, camels, deer,[6] birds, gold, jewels," &c. The qualifications of such men have been already noted in connexion with goats and sheep. The leaping of the deer is well-known and supplies the technical term for a pace of horses: "The pluta movement is that in which the horse leaps with all the four legs like the deer."[7]

The prices of deer have not been noticed, nor also the revenue derived from them.

iv. Suidæ.

The Suidæ or Boar-Family has supplied an avatâra or incarnation of Viṣnu, as we have previously noticed, in Hindu mythology. In the *Sukranîti* we do not read much of it. The tradition is recorded that one of the sources of pearls is the hog.[8]

[1] Sukra IV, ii, 239-40.

[2] See Coomâraswâmy's *Selected Examples of Indian Art.*

[3] Sukra I, 203-4. See also III, 33-34.

[4] Sukra V, 62-63.

[5] Sukra I, 450.

[6] Sukra II, 297-298.

[7] Sukra IV, vii, 204.

[8] Sukra IV, ii, 117-18.

(*e*) *Cetacea.*

The whale is known to be an aquatic animal. It is symbolical of huge size. Sukrâchâryya teaches man humility by the following illustration: "One should remember that there is the animal which devours the devourer of whales,[1] Râghava is the devourer of that even, and there is the destroyer of Râghava." So the rule[2] is that the wise man should never consider "I am superior to all, I am more learned than others."

SECTION 6.

Aves in Sukranîti.

Birds[3] are mentioned along with the cattle and other animals as some of the attractions of the place where the capital city is to be built. The economic importance of this department of Fauna is further shown in *Sukranîti* by the provision for the appointment of a special staff to look after the birds[4] maintained by the state. Some of the battle-orders in which troops are enjoined to be arrayed indicate careful observations of the limbs of the aves and their habits, &c.

(*a*) *Passeres.*

Passeres[5] constitute more than half of the Birds of India; but only one family of this order has been mentioned in Sukranîti, *e.g.*, the Eulabetidæ. The bird gackle, talking mainâ or hill mainâ which belongs to this family is to be used in the examination of royal food. The toxicological principle is the fact that the bird begins vomiting at the very sight of poisoned food.[6]

(*b*) *Coccyges.*

The cuckoos belong to the Cuculidæ Family of this order. The shout of the bird is traditionally known to be sweet and has been much poetised both in the east and west. In advising people to learn restraint and gentleness in speech, Sukrâchâryya remarks that "the voices of the drake red with passion, the cuckoo[7] and the peacock are not so attractive as those of the good and the wise." It requires to be noted here that poets have not bestowed much attention on the talking mainâ which has the wonderful power of imitating human voice.

(*c*) *Psittaci.*

To this order belong the parrots, which can be made to acquire human voice like hill mainâs. Among the qualifications of persons to be appointed to the Department of Live-stock, one is the ability to teach parrots,[8] (and birds

[1] Sukra III, 440-47.
[2] Sukra III, 444-45.
[3] Sukra I, 425-28.
[4] Sukra II, 237-38.
[5] Indian Empire, Vol. I, p. 289, in *Imperial Gazetteer.*
[6] Sukra I, 654-57.
[7] Sukra I, 337-38.
[8] Sukra II, 300-02.

generally). Sukrâchâryya refers again to the educability of these birds in the following lines :

"The elephant, the horse, the ox, the child, the wife and the parrot[1] get the qualities of their teachers through association."

(*d*) *Accipitres.*

To this order belong the Indian birds of prey. The Syena or hawk is the only bird mentioned in Sukraniti that may be placed in one of the families of this very great order. One of the qualifications of men to be appointed in charge of birds and animals is the knowledge and skill of catching hawks[2] by appropriate enticements. They must know when such birds fall victims to arrows. This bird has supplied a technical term to military science. One of the forms of battle array is known to be the syena or hawk-order or order with two wings. The soldiers are to be arrayed in this form when the enemy is known to have placed danger ahead,[3] *i.e.*, when the army has to encounter a front attack. It is the order in which the wings[4] are large, the throat and tail medium, and the mouth small.

(*e*) *Columbæ.*

Pigeons or Treroninæ are common Indian birds belonging to the Columbæ order. This bird also has supplied the form of a battle order called after it the *Krauncha Vyuha*[5] or Pigeon array. It is to be formed according to the nature of the region and the troops in the same rows as the movements of pigeons in the sky. It is that order in which the neck is thin, the tail medium and the wings thick.

(*f*) *Gallinæ.*

This order comprises the common Game Birds of India, *e.g.*, pea-fowls, jungle-fowls, pheasants, partridges, quails, &c. This order is well-represented in Sukraniti.

The peacock's divided note is called *keka* in Indian literature, and the bird itself is held sacred *e g.* by several ruling dynasties. It is the *vâhana* of the war-god *Kârtikeya.* Sukra authors, as we have seen above,have recorded the tradition about its voice. "The man who is popular speaks sweet words like the notes of the peacock."[6] "But the voice of the peacock is not so sweet as that of the good and the wise. So one should use pleasant words both to good men and enemies. The sensitiveness of peacocks to poisons is a test to be utilised in the examination of royal food; for at the sight of poisons, toxicologists say, peacocks begin to dance.[7] The feathers[8] of the bird are known to the Sukra authors as possessing bright lustre ofemerald or pâchi. Its long neck has also been observed. The gait of the horse is called *valgita*

[1] Sukra III, 582-583.
[2] Sukra II, 300-302.
[3] Sukra IV, vii, 527-28.
[4] Sukra IV, vii, 550.
[5] Sukra IV, vii, 556-58.
[6] Sukra I, 385-38.
[7] Sukra I, 654-57.
[8] Sukra IV, ii, 87.

when it runs with contracted legs, neck raised like that of the peacock[1] and half the body trembling.

The jungle-fowl or the cock[2] is known to cry at the very sight of poison. This supplies a test to the medical officers superintending the royal kitchen.

The tittira or partridge has been referred to only once. It is stated that the men in charge of birds should be competent enough, among other things, to domesticate the partridges.[3]

(*g*) *Grallæ.*

The Gruidæ or Crane-Family is one of the many families belonging to this order that has been mentioned in Sukranīti. Cranes get intoxicated[4] at the sight of poisons. Hence, their utility to men and especially to princes who should always have their food examined before meals.

(*h*) *Anserees.*

Ducks belong to this order. These birds begin to limp[5] at the very sight of poisons. This sensitiveness is to be utilised by the medical men of the palace. Drakes or Swans or Ganders are also famous in Indian poetry as emblematic of passionate love. Their notes are known to be sweet like those of the cuckoo and the peacock. Thus we have the advice regarding cultivation of restraint and gentleness in speech : " The voices of the drake[6] red with passion, the cuckoo, and peacock are not so attractive as those of the good and the wise."

SECTION 7.

Reptiles in Sukranīti.

According to the *Fauna of British India* (1890-1900) there are altogether 153 genera containing 558 species of reptiles in India. These belong to three orders: (1) *Emydosauria* or Crocodiles ; (2) *Chelonia* or Tortoises and Turtles and (3) *Squamata* or Lizards and Snakes.

"The Reptiles of India[7] are far more numerous than mammals and more destructive to human life ; snake-bites alone cause more deaths than all the wild beasts together."

It is not strange, therefore, that Reptiles should have made a deep impression on the life, habits and thought or literature and art of the people of India in ancient and mediæval times. Sukranīti is full of references to reptiles, especially to snakes, indicating the great familiarity of the authors and their countrymen with these species of Fauna, whether they willed it or no.

(*a*) *Emydosauria.*

The *makara* or alligator is a very familiar river animal. It has left its influence on Hindu religion, art and industry. It is sacred to the goddess Gangā, one of the national rivers of the Hindus. The goldsmiths and jewellers

[1] Sukra IV, vii, 297-98.
[2] Sukra I, 054-57.
[3] Sukra II, 297-298.
[4] Sukra I, 054-57.
[5] *Ibid.*
[6] Sukra I, 337-338.
[7] *Imperial Gazetteer of India*—Indian Empire, Vol. I, Chap. V, Zoology.

manufacture the alligator pattern of ornaments and decorative devices much appreciated by connoisseurs. The national taste of the people also finds satisfaction in the alligator shapes perpetuated in sculpture and painting.

Nor is this all. This family of reptiles has contributed a technique to military science or *Dhanurveda*. Thus, according to *Sukraniti*, one of the recognised Battle-orders is the alligator array[1] in which the commander should arrange his troops when he has to face an opposition in the front. This *vyuha* or array[2] is described as that form which has four legs, long and thick mouth and two lips. There is no doubt that the formation is based on a correct observation of the external organs of the animal.

(*b*) *Chelonia*.

Tortoises are sacred to the goddess Yamunā, another holy river of the Hindus in upper India. Like the Boar, this species of Fauna has contributed an avatāra, or one of the 10 divine incarnations, to Hindu mythology. The animal has been referred to only once in a passage that describes at once its physique as well as an important feature of the material civilisation of ancient India. The Sukra ideal of road-making is given in the following line: "The roads are to be made like the back of a tortoise[3] (*i.e.*, high in the middle), and should be provided with drains on both sides for the passage of water."

Tortoise[4] shells seem to have been some of the articles of trade in the early Christian era. The *Periplus* records that from the port of Muziris on the Arabian coast, famous also in Tamil classics, the list of exports included among other things "tortoise shell from the golden Chersonese or from the islands off the coast of Limurike."

(*c*) *Squamata*.

The dangerous character of snakes is too well-known. But bad men are more dangerous than they. The advice, therefore, is that "one should associate rather with snakes[5] whose mouths contain poison and whose faces have been darkened by the smoke of fire exhaled by their breathings, but never with bad men."

Like the tiger, the snake is also emblemical of fury and vehemence. One of the attributes of the king is fury and prowess. He is therefore naturally compared with a snake,[6] and officers are advised to approach him with caution.

The snake is never to be pitied or neglected. "The snake,[7] the fire, the wicked man, the king, the son-in-law, the nephew, the disease, and the enemy —these are not to be regarded as being too small." Expeditions against snakes[8] must, therefore, have been common. The advice is "one should not go alone to attack snakes, tigers and thieves"

Another reference to dangerous things includes snakes also. "Association

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[1] Sukra IV, vii, 527, 528.

[2] Sukra IV, vii, 500.

[3] Sukra I, 531-32.

[4] Aiyangar—Ancient India, p. 65.

[5] Sukra I, 327-28.

[6] Sukra 430-31

[7] Sukra III, 212-13.

[8] Sukra III, 323.

with tiger, fire, snake[1] and other ferocious animals is not good. Even when served, the king and these things can never be friends to anybody."

Snake-charming[2] was practised, as even now. The power of the snake-charmer over the snake supplies a very characteristic analogy : " The minister masters the king by the force of mantra (charm or counsels), just as the snake-charmer subdues the snake."

Of the above extracts, four come from a single chapter, that on the general rules of morality. As all the references are but casual, they indicate the enormous impression made by venomous snakes on the general thought of the people.

The same topic about the natural or ingrained maleficence of snakes is harped on in the following verses : " Instructions to foolish people are the causes of their anger, not pleasure; just as the drinking of water by snakes[3] is for the making of poison, not of nectar."

Sukra authors have recorded the tradition of gems being borne on the heads of snakes. " The gem on the head of the snake[4] is the best of all, of very great splendour, but very rare. Snakes[5] are also said to constitute one of the sources of pearls. The real explanation of the popular idea has been given in the chapter on mineralogy. The snakes have to pick up bright stones in their mouths when they move about in the dark. These stones are their lamps, so to speak, and serve the purpose of pointing out their paths.

The snake has contributed one battle-formation named after itself. The vyâla or snake array[6] should be devised by the commander when the danger is on all sides. It looks like the snake.[7]

Further references to snakes are given below :—

(1) As an ordeal or *divya* : The accused has to swallow poison or catch the poisonous snake[8] by the hand ; and if he gets scot free, his innocence is proved ; otherwise not.

(2) The earth swallows the king who does not fight, and the Brahman who does not go abroad, just as the snake[9] swallows the animals living in the holes.

(3) One should keep five cubits from the carriage, ten cubits from the horse, one hundred cubits from the snake,[10] and ten cubits from the bull.

[1] Sukra III, 518-19.
[2] Sukra III, 561-62.
[3] Sukra IV, i, 37-38.
[4] Sukra IV, ii, 96.
[5] Sukra IV, ii, 117-118.
[6] Sukra IV, vii, 529-31.
[7] Sukra IV, vii, 565.
[8] Sukra IV, v, 478.
[9] Sukra IV, vii, 604-5.
[10] Sukra III, 281-2.

SECTION 8.

Pisces in Sukraniti.

Fishes and Fish life are well-known to Sukra authors. Fishing and angling must have been familiar practices. Thus one of the illustrations in Sukranîti about the bad effects of the inclination to satisfy the sense of taste, one of the classical *vyasanas* or vices, is drawn from angling: "The fish,[1] though it dives into unfathomed depths and lives in distant abodes, tastes the angle with meat for death." The fish is thus the object lesson for the danger from *rasa* or taste. This fact has been recorded again: "The deer, the elephant, the fly, the bee, and the fish[2]—these five are ruined through sound, touch, form, smell and taste respectively."

Fish-eating[3] is also known; but it is described as a local custom confined to *madhyadesa*. The limits of the country indicated by it have been discussed in the chapter on Geography. It has been suggested that the ideal advocated or 'norm' represented by the Sukra authors is one of vegetarianism, fish-eating being something abnormal. It has to be noted that in Sukranîti there is no mention of fishermen as a class,[4] fishing as a kalâ, or realisation of revenue from that industry. It may be surmised that it is not one of the state-recognised occupations of the country according to Sukranîti, the people among whom or for whom it was compiled being generally abstemious in the matter of fish and meat diet.

Fishes are known to be sources of pearls.[5]

Like the tiger, the fish also supplied an emblem of kings. In the Tamil classic, Epic of the Anklet, (2nd cent. A.D.) "there are a number of references throughout the work to the erecting of the fish-emblem[6] on the Himalayas. * * * These achievements are clearly ascribed to the reigning Pandyan in Canto xvii."

SECTION 9.

Invertebrates in Sukraniti.

Sukranîti is not so rich in observations regarding habits, habitats and organs, &c., of invertebrates as of vertebrates, especially Aves and Reptiles.

Conches belonging to the *Mollusca* class of Invertebrates are very important in Hindu religious ceremonies. The notes produced by blowing the shells of these molluscs with the mouth are integral features associated with auspicious and purificatory occasions. In Sukranîti these are mentioned together with drums, trumpets, pipes &c., as ware-paraphernalia to indicate by their sounds, like bugles, the construction of battle-arrays.[7] They are also known to be the sources of pearls,[8] like snakes, fishes, &c. Their colour is

[1] Sukra I, 209-210.
[2] Sukra III, 33-34.
[3] Sukra IV, v, 95-96.
[4] Sukra II, 390-411.
[5] Sukra IV, ii, 117-118.
[6] Aiyangar's *Ancient India*. p. 356.
[7] Sukra II, 402-3.
[8] Sukra IV, ii, 117-118.

characteristic. The teeth of horses[1] acquire this colour from the twenty-first year.

Varâtis or cowries are also smaller species of the same order important in Indian economic life as a form of what is technically called "money." These are the lowest coins for the standard of value and medium of exchange. They are mentioned in Sukraniti only in connection with currency,[2] as indicating its unit.

A third species, belonging to the Mollusca, mentioned in Sukraniti, is known to be the most prolific source of pearls. It is the oyster-shells.[3] It is the pearls derived from these shells that are used in ornaments, for these alone can be bored or pierced.[4]

Besides molluscs, the Sukra authors have referred to several tiny insects belonging to the *Invertebrata.* Like the fish, the fly[5] is an object lesson for one of the six *vyasanas* or vices of Hindu Ethics. "The fly gets death by falling suddenly into the lamp, because of its mad passion through gratification of eyes by the light of the wick in a mild lamp." The danger of men from pleasures of *rupa* or sight is thus illustrated by the case of the fly. Similarly, the bee[6] illustrates the danger from *gandha* or smell. "The bee which has the power of cutting holes, and can fly with wings, gets, however, caught within a lotus because of its desire for smell." This lecture on the necessity for the control of the senses and the practice of self-restraint is repeated in the chapter on General Rules of morality: "The antelope, the elephant, the fly, the bee and the fish—these five are ruined through sound, touch, form, smell and taste respectively." So one should duly enjoy these things with restraint.

Another characteristic of bees has been recorded. At the very sight of poisoned food bees[8] begin to hum. This supplies a very good test for the detection of poisons, and is utilised by toxicologists.

Ants and worms have been referred to in Sukranîti—generically to indicate the meanest and minutest creatures of the animal world in the lines describing the ideal of *ahimsâ* or charity, mercy and philanthropy that people should hold before themselves: "One should serve as far as possible people who are out of employment, who are diseased, and who are aggrieved; should always look upon even ants and worms[9] as oneself; and even if the enemy be harmful, should be doing good to him."

SECTION 10.

Agricultural Live-stock in Sukranîti.

We have mentioned above that the *Ungulates* of the Vertebrate kingdom supply all the more important animals of domestic, social, and economic life. In

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[1] Sukra IV, vii, 321-24.
[2] Sukra IV, i, 234.
[3] Sukra IV, ii, 117-118.
[4] Sukra IV, ii, 123.
[5] Sukra I, 207-8.
[6] Sukra I, 211-12.
[7] Sukra III, 33-34.
[8] Sukra I, 654-657.
[9] Sukra III, 20-22,

this section we propose to deal with the animals specially useful in agriculture. Such animals are (1) Bulls and bullocks, (2) Cows, (3) Buffaloes, both male and female, (4) Sheep, (5) Goats, (6) Horses and ponies, (7) Mules and donkeys, (8) Camels.[1] We have already disposed of sheep and goats in a previous section; and, as in Sukraniti, camels and horses are put specially to military purposes, we reserve their treatment for a subsequent section. Bulls also have been mentioned as draught cattle for the military establishment, but their importance in agriculture and ordinary conveyance is, however, well-known. We proceed, therefore, to cull from Sukranīti all references to cattle, ploughs, carts, &c., that have any bearing on agriculture.

Both agriculture and pasture are included in the list of topics dealt with in the science of *Vārtā*, which coincides more or less with the modern science or art of Economics. "In *Vārtā*[2] are treated interest, agriculture, commerce and preservation of cows." As Vārtā is a branch of learning recognised in the curriculum of studies for princes, we may take it that matters connected with veterinary science, agricultural live-stock, entomology, &c, such as they were, had to be studied by persons who were called upon to rule over the destinies of mankind.

The cattle, however, affect the people more than princes. In *Sukraniti* we therefore have references to agriculture and the breeds of animals employed in it, specially in connexion with the activities of the people. Sukrachâryya has described the tending of cattle and cultivation of lands as two of the occupations of Vaiśyas,[3] and the driving of plough as one of the occupations of Sudras.[4] It is difficult to see the difference between cultivation of lands and drawing of ploughs, unless the former implies supervision or high class intellectual work in connexion with agriculture, and the latter purely mechanical, manual work. Whether Vaisya or Sudra, the cultivator certainly forms an important member of Sukrachâryya's social system with his own customs, rites, traditions. It is, therefore, definitely laid down as a juristic principle that "The cultivators should have their disputes[5] decided according to the usages of their own guild, &c." And the drawing of ploughs is a kalâ.[6]

What would be called "Simple Co-operation" in modern phraseology is indicated in the following rule regarding agricultural life: "The women should be assistants[7] in the functions of males, *viz.*, agriculture, &c." We have here a maxim of the Cottage Industry System rendered natural through the organisation of the Joint-Family.

The only reference to the use of cattle in agriculture is in the lines, on the authority of Manu, describing the resort of Brahmanas to this occupation under certain conditions.[8] The conditions are that Brahmans must have 16 animals

[1] In the Punjab, Sind, and Western Rajputana camels are largely used for agricultural purposes instead of bullocks.

[2] Sukra I, 311-12.

[3] Sukra I, 83-84. See also IV, iii, 34.

[4] Sukra I, 85-6.

[5] Sukra IV, v, 35-36.

[6] Sukra IV, iii, 188.

[7] Sukra IV, iv, 54.

[8] Sukra IV, iii, 37-40.

to their ploughs. Kṣatriyas, when they take to agriculture, should have 12 cows. The normal number, *e.g.*, that for Vaisyas is 8. The Sudras may have 4 cows and the Antyajas 2 only. The difference in the number of cattle to be employed for the same work according to the caste of the worker, seems to have been justified in those days by the idea that, in the case of those whose normal occupations were non-agricultural, *e. g.*, Brahmanas and Kṣatriyas, agriculture should be looked upon when they do take to it, as an *āpaddharma*; and as they are not used to it, they should have as helpmates a larger number of cattle to relieve them of the physical strain than those whose ordinary occupation being manual does not require the extraneous help. The authority of Manu and other sages has been invoked to prove the legitimacy of agriculture being an occupation of Brahmanas.

The conditions of good cattle are indicated in the following line:

"The cow[1] with good horns and fine colour, which gives plenty of sweet milk, and has good calves has very high value, whether young, small or large."

The prices are given below:

(1) A good cow costs Rs. 8, *i.e.*, twice the price of a she-goat.[2]

(2) The high price for cows is, however, Rs. 64, or Rs. 80.

(3) The high price of a buffalo[3] is the same as that of the cow or one and a half times that, *i.e.*, Rs. 64 or 80, or 96 or 120.

(4) The high price for she-buffaloes[4] is Rs. 56 or Rs. 64, *i.e.*, lower than that for the male cattle.

The revenue[5] from agricultural cattle is realised at the following rates:

(1) One-eighth of the increase of cows and buffaloes.

(2) One-sixteenth of the milk of she-buffaloes.

The milk[6] should never be received by the king for his own kith and kin.

Carts have been referred to—not, however, in connection with agricultural purposes, but with the military establishment. But ordinary carts are implied in the following proverbs: "It is better to be poor first[7] and rich afterwards, just as it is better to be a pedestrian first and go in a vehicle afterwards." Also, "Pedestrianism is better than using bad vehicles."[8]

We have just noticed that only the cow has been specifically mentioned in Sukraniti as the agricultural live-stock. But much information on this head is not available from it. It requires to be noted, however, that the Sukra authors represent one of those stages in the history of Hindu national sentiment which gave concrete shape to the idea of the cow as a divinity. Thus as one

[1] Sukra IV, ii, 180-187.
[2] Sukra IV, ii, 188-189.
[3] Sukra IV, ii, 193.
[4] Sukra IV, ii, 196.
[5] Sukra IV, ii, 239-240.
[6] Sukra IV, ii, 253-54.
[7] Sukra III, 569-70.
[8] Sukra III, 572-3. See also the references to carts drawn by horses as the conveyances of commanders and governors. V, 162-9.

of the most justifiable "grounds for war," according to the principles of International Law advocated by Sukrâchâryya, we read what may be compared with the cry of Sivâji, the great Hindu monarch of the 17th century: "There are no rules about the proper or opportune time and season for warfare in cases created by the killing of cows,[1] women, and Brahmanas." The physical considerations of time, place &c., must not weigh when the most vulnerable point of national honour and feeling has been touched by the adversary.

It may be possible to find out the age of *Sukraniti* from the history of this "Doctrine of the Divinity and Inviolability of the Cow" as a corner-stone of Hindu socio-religious system. The work must be attributed to a period not preceding the advent of the Musalmans, with their alien creed as a formidable rival to contest the sovereignty of the land with the people of Hindusthan.

It may be interesting to add here that in the western countries also thinkers have been gradually coming to appreciate the Cow-cult in their own way. Thus to quote from the *Encyclopædia Britannica* (Article on Dairy):

"If civilised people were ever to lapse into the worship of animals, the Cow would certainly be their chief goddess. What a fountain of blessings is the cow! She is the mother of beef, the source of butter, the original cause of cheese, to say nothing of shoe-horns, hair-combs and upper leather. A gentle, amiable, ever-yielding creature, who has no joy in her family affairs which she does not share with man. We rob her of her children that we may rob her of her milk, and we only care for her when the robbing may be perpetrated."

SECTION II.

Economic Zoology in Sukraniti.

The various references in which the Fauna have been mentioned by Sukra authors must have given us an idea of the uses which their country-men made of the animal world. The importance of animals in military life will be dealt with in the next section. In the meanwhile, we shall mention the odds and ends of the economic zoology of Sukrâchâryya that cannot be covered by all these.

Of course milk is one of the most important products of the animal world. Among the 64 kalâs we have two connected with this, *viz.*, milking[2] and churning. Similarly, ghee is also mentioned in Sukranîti as an article of great economic importance. One of the important items of State Interference in Indian Industry and Commerce seems to have been the prevention of Adulteration of Foodstuffs. We find even Sukrâchâryya combatting this evil.[3] The regulation is given in the following lines: "Falsehoods[4] must not be practised by any one with regard to ghee, honey, milk, fat, &c." Sukrâchâryya's state is a guardian

[1] Sukra IV, vii, 453. [2] Sukra IV, ii, 182.

[3] See the articles on *Adulteration* and *Dairy* in *Encyclopædia Britannica.*

[4] Sukra I, 590-2.

of the people's health and wealth, according to what Sidgwick would call the "Socialistic principle."

Not these innocent industries only—but even the more cruel and untouchable ones are noticed in Sukraniti. Thus, in addition to the above two kalās, we have three more connected with animal life in the list of 64 arts:

(1) Softening of leathers.[1]

(2) Flaying of skins from the bodies of beasts.[2]

(3) Extraction of oil from flesh (fats).[3]

It is to be understood, as a matter of course, that the chemical and mechanical processes allied or auxiliary to the above industries must also have been well-known.

Commerce and Industry in leather must have been important enough. We do not find any reference to fishermen as a class or fishing as an occupation, as we have already noted. But we read of bird-catchers and leather merchants[4] among other classes of persons who deserve state encouragement.

And at least one product of the leather-industry was in universal demand, *e.g.*, shoes. Thus, among the general rules of morality to be observed by both people and princes, we have the following: "One should always bear medicinal substances in jewels, &c., consecrated by mantras, have umbrellas and shoes,[5] and walk in the streets with eyes fixed on the straight path only." Here we have the ideal of material life that a gentleman of the Sukra-days was expected to follow; and shoes form an item in what would have been regarded as the 'proper' or decent dress of a householder. That the use of shoes was common enough would be evident from the following happy adage of Sukrāchāryya also: "It is better to cover feet with shoes[6] than try to cover the whole earth with leather."

Flesh or meat as a diet is known to the Sukra authors, but, like fishing, eating it is a purely local custom confined to the artisans and artists of Madhyadesa.[7]

Worms and Insects[8] as destroyers of grains are known to Sukra authors. They have advised the king not to accumulate for future use those that have been thus attacked by pests. Information, however, is not copious.

Dr. Rājendralāl has pointed out in his Essay on Dress and Ornament in Ancient India that, among the presents brought by princes and potentates of various parts of India to king Yudhisthira, referred to in the Sabhāparva of the *Mahābhārata*, various skins are mentioned. The skins of animals that lie in holes, and of wild cats, *i.e.*, the furs of varieties of martin and weasel families, were brought by the Kambojas of the Hindu Kush; Blankets by the Abhiras of Gujrat;

[1] Sukra IV, iii, 180.
[2] Sukra IV, iii, 181.
[3] Sukra IV, iii, 187.
[4] Sukra II, 409-407.
[5] Sukra III, 8-9.
[6] Sukra III, 574.
[7] Sukra IV, v, 9-496.
[8] Sukra IV, iii, 56-57.

Clothes of the wool of sheep and goats or thread spun by worms (silks) by the Scythians, Tukhâras and Kankas; housings for elephants by princes of the Eastern tribes, lower Bengal, Midnapur, and Ganjam. Pâṇini also, has not only given words for wool, cotton, weaving, cloth, turbans, sewing, &c., but also for gives a special rule (IV, iii, 42). Woollen stufts and furs as well as silks are silk for which he mentioned by Vâlmîki among the constituents of Sitâ's trousseau (Râmâyana, I, 74). It may also be added that animal products, *e.g.*, the hair of Yak, Gour, Gayal and other bovine animals living in hills were used in the manufacture of one species of *châmaras*, or fly-flappers, described in the Yukti kalpataru as one of the most important insignia of royalty. Some idea of Economic Zoology may be formed from the fact that the author mentions the Meru, Himâlaya, Kailâsa, Malaya, Vindhya, Gandhamâdana and other mountains as the habitats of the animals yielding the requisite hairs of various kinds.

Dr. Râjendralâl has described some of the shoes and boots in Hindu India in his *Indo-Aryans*. We know the tender story of Bharata's placing a pair of Râma's slippers on the vacant throne of Ayodhya to officiate for him during his exile. Mediæval Sanskrit authors allude to them pretty frequently. The *Viṣṇu Purâṇa* enjoins all who wish to protect their person never to be without leather shoes. Manu forbids the use of others' shoes (IV, 66), as Sukra considers the use of others' gold and jewels, &c., as a *chhala* or social offence. The Purâṇas recommend the use of shoes in thorny places and on hot sand. Arrian notices the Indian shoes made of white leather, which, according to the description given, may be identified with the Uriya shoes of to-day.. According to Mitra the material for these boots and shoes was bovine leather, and even the hide of sacrificed cattle. Âswalâyana quotes Sânvatya (IV, ix, 24) to mention the fact that the hide of cattle sacrificed in Sulgava ceremony is fit to be converted into shoes and other useful articles. So also hog-skin is a fit material for shoes according to a Vedic verse quoted by Savara Swâmi in his commentary on the Mimâmsa aphorisms. Râjendralâl also mentions leather bottles, leather jars (*driti*s in Manu); leather straps, strings and bands, leather sails, &c.

The following extract from Mr. Law's *Hindu Polity* based on the Arthasâstra of Kautilya would give an idea of the Economic Entomology or agricultural Zoology of the Hindus in the 4th cent. B. C. " It should be remarked that measures for the extermination of pests were also undertaken by Government. These pests generally included rats, locusts, injurious birds and insects and tigers. To destroy rats, cats and mungooses were let loose; some varieties of poison were also used for the purpose. To kill tigers, several kinds of posion were in use."

On the strength of evidences from Tamil sources bearing on South Indian life of the early Christian era, Aiyangar says[1]: " Among the woollens we find mention of manufactures from the wool of rats which was regarded as particularly warm. There are 30 varieties of silks mentioned, each with a

[1] *Ancient India* p. 65.

distinctive appellation of its own, as distinguished from the imported silks of China which had a separate name."

Marco Polo (1792 A.D.) describes Cambay as a port with "great trade in hides, which are very well-dressed."

According to the *Dharma Sutra* of Baudhâyana (i. 2.4), traffic in wool and in animals with two rows of teeth (horses, mules, &c.) is a forbidden practice in the Dravidian districts,—the locale of this work according to Buhler,—but is common among the "Northerners" (*i.e.*, Western and North-western India, according to the geographical terminology of those days recorded by Hiuen Thsang also).

The following extract from the *History of Indian Shipping* pp. 77-78 relates to the traffic in animals in ancient times: "Lastly, there are several other *Jâtakas* in which we are told explicitly of a successful, if sporadic, deal in birds between Babylon and Benares, and of horses imported by hundreds from the North and from Sindh." The author quotes *Tandulanali Jâtaka*, *Suhanu Jâtaka*, *Kundaka-Kucchi-Sindhava-Jâtaka*, *Bhojajanuya-Jâtaka* and *Ajanna Jâtaka* and also Mrs. Rhys Davids' articles in *Economic Journal* and J. R. A. S. for 1901. In the days of Solomon also Indian peacocks, &c., found customers in Syria.

Prof. Mookerji quotes the *Baveru-Jâtaka* and the opinions of Buhler, Rhys Davids and Kennedy to show that peacocks were first taken to Babylon by Indian sea-going merchants in the 6th cent. B.C.

Section 12.

The Animal Corps in Sukraniti.

Horses, elephants, camels and bulls constitute the animal-corps of the Sukra state. The general rule about the relative proportion of these animals in the army is given in the following line: "The king should have in the army a predominance of footsoldiers, a medium quantity of horse, a small quantity of elephant force, equal number of bulls and camels, but never elephants in excess."[1] This is stated more definitely as follows:[2]

Infantry	should be	4	times horse.
Bulls	"	$\frac{1}{5}$	"
Camels	"	$\frac{1}{8}$	"
Elephants	"	$\frac{1}{32}$	"

Thus the number of elephants is to be the smallest, the bulls and camels may be equal in amount or differ as $\frac{1}{5}$ or $\frac{1}{8}$ of horse.

The idea of Sukra statesmen is clearly known from the statement of the constituents of the Army in a state whose annual income is Rs. 1,00,000. The ruler of such a state[3] is advised to have

(1) 80 horses.	(3) 2 elephants.
(2) 10 camels.	(4) 16 bulls.

[1] Sukra IV, vii, 45-6. [2] Sukra IV, vii, 41.
[3] Sukra IV, vii, 47-52.

The budget of expenses on the military live-stock of this "unit" of political life is explicitly stated to be as follows:—

(1) Horse (and Foot) ...	...	Rs.	48,000 per year.
(2) Elephants, Camels, Bulls (and Fire-arms)...		"	4,800
	Total Rs. ...		52,800

The importance of the department of live-stock to the state would be evident from the fact that, together with (1) the Infantry and (2) the Fire-arms and other accessories, *e.g.*, chariots, carts, &c., the horses, elephants, camels and bulls constitute more than half of the permanent charges upon the finances of the kingdom. It is clear, therefore, that all Hindu financiers and statesmen, as well as rulers must have made themselves thoroughly well-grounded in the knowledge of habits, habitat, feelings, rations, stabling, embryology, anatomy, external characteristics, health, prices, classes, measurements, mettle, &c., of the live-stock. It is this which explains the abundance of Zoological lore among the Hindus, and the production by their scholars of works on economic zoology, veterinary science, physiology, &c., dealing with all the theoretical and practical or scientific and utilitarian aspects of Indian Fauna.

Besides the purely military uses of these animals, Sukranīti records some other uses also. The following reference to the animal-force indicates non-military as well as military uses: "The elephant,[1] the camel, the bull, the horse are excellent beasts of burden in the descending order. Carriages are the best of all conveyances except in the rainy season."

The use of horses for purposes of conveyance is further referred to in what looks like modern "horse-allowances" described in the following lines: "(1) The master of 10 villages, and the commander of 100 troops should travel on horseback with attendants; (2) The master of one village also should be a horseman; (3) The commander of 1,000 troops and the ruler of 100 villages should each have the conveyance of a chariot or cart and a horse, and 10 armed attendants should travel on horseback. (4) The ruler of 1,000 villages should always travel in vehicles carried by men or two horses. (5) The ruler of 10,000 villages can use all vehicles and four horses."

The use of elephants, also, as conveyance is granted to the "dignified parts" of the state: "The commander of 10,000 troops should travel on an elephant[3] with 20 attendants."

The references to carts or carriages drawn by horses should be noted.

Horse-Sacrifices have also been incidentally mentioned in *Sukranīti.* "Can virtue that is begotten of *aśwamedha*[4] come out of mere recital of hymns? So also, can the virtue arising from mercy come out of punishments?" The analogy is quite worthless, however. The horse to be used in the sacrifice would perhaps be called *Śyâmakarṇa*[5] according to the taxonomy in Sukranīti.

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[1] Sukra IV, vii, 352-53.
[2] Sukra V, 162-168.
[3] Sukra V, 167.
[4] Sukra IV, i, 108-9.
[5] Sukra IV, vii, 221-22.
[6] Sukra I, 622.

So also the religious ceremony in connexion with the *utsarga* or letting out or consecration of bulls is referred to. There is a law of the land regulating the people's action with regard to the custom: "Those who have let out bulls and other animals (after religious observances) must keep them within proper control"; *i.e.*, the animals must not be allowed to destroy public property or cause damages to the interests of the citizens.

The following is a general rule of morality to be observed by pedestrians while walking, and indicates the degree of danger that is to be feared from the animals: "One should keep 5 cubits from the carriage, 10 cubits from the horse,[1] 100 cubits from the snake, and 10 cubits from the bull."

Like the goats, the bulls are also known to Sukra authors to be stupid animals. Thus those kings are almost like oxen[2] (*i.e.*, fools) by whom their strength (army) is not increased, by whom princes are not made to pay tribute, and by whom subjects are not well-protected.

The elephant has left its deep mark on Hindu thought. Both Literature and Fine arts of the Hindus have preserved the most characteristic representations of this animal's internal and external features The rut gushing out of the elephant is a conventional symbol with Hindu poets for the excitement of passion in both physical and moral worlds. The havoc created by the animal in fury has also been the theme of many a noble specimen of Hindu sculpture and literature.

The moral lessons illustrated by the Sukra authors from the habits of this animal are given below: —

(1) There is a complete analogy between the processes of training elephants and the senses of man. "One should bring to bay or discipline, by the hook of knowledge, the elephant[3] of the senses which is running to and fro in a destructive manner in the vast forest of enjoyable things." This simile about wild and unbroken elephants is one of the most common devices in Sanskrit literature.

(2) The elephant is the object lesson, among other things, of the danger from the weakness of Touch-enjoyment: "The elephant[4] whose stature is like the peak of a mountain and who can uproot trees with ease, is, however, caught, because of the pleasure of contact with the female." This is expressed again, in the following: "The antelope, the elephant,[5] the fly, the bee, and the fish—these five are ruined through sound, touch, form, smell and taste."

Two professions have been incidentally noticed here, *e.g.*, those of catching and training the elephants.

The elephant is known to be proverbially huge and strong. "It is only the powerful elephant,[6] that can extricate an elephant from the mud. So also, it is a king who can deliver a king who has gone astray." Again, "The elephant[7] cannot be bound by thousands of bales of cotton."

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[1] Sukra III, 281-2.
[2] Sukra I, 249-50.
[3] Sukra I, 193-94.
[4] Sukra I, 205-6.
[5] Sukra III, 33-34.
[6] Sukra IV, vii, 834-35.
[7] Sukra IV, vii, 833.

But the elephant is no match for the lion : "Just as even the tiger and the elephant[1] cannot govern the lion—the king of beasts—so all the councillors combined are unable to control the king, who acts at his own sweet will."

We have already referred to the use of elephants as conveyance granted to the very high officials of the state. It is also advised that "the king should tour the city on the back of an elephant,[2] in order to please the people."

SECTION 13.

Horses.

(*a*) *External Anatomy.*

The anatomy and external characteristics of horses were very minutely studied. The fact that the Hindus laid down mathematically accurate rules for the artists to follow and demanded of them a strictly religious observance of those rules presupposes, and is an evidence in favour of, the view that they were past masters in anatomical surveys of the human and animal bodies. To those who would construct the images of horses, Sukrâchâryya's advice is: "If an image is to be made, the appropriate pattern or model should be always placed in front. No image can be made without a model. So the artist should frame the limbs after meditating on the horse[3] and finding out the measurements and attributes of horses in the manner indicated above." "In horses all limbs are made according to a certain proportion with the face."

The measurements of horses' limbs given by Sukrâchâryya will be explained in the section on the anatomy of the vertebrates.

(*b*) *Mettle and Worth.*

The appreciation of horses and their classification according to merit depend on the consideration of the following circumstances, both zoological and economic : (1) measurements of limbs, (2) certain general aspects and physiognomical features, and (3) marks on the animal's body, *e.g.*, feather-rings, &c., which are known to be auspicious or inauspicious, also (4) the place from which they come. But this last has not been described in Sukranîti.[4]

According to the measurements of limbs, we get the following tradition recorded by Sukra authors :

(1) The best horse[5] has a face of 24 angulas or inches.
(2) The good „ 36 „ „
(3) The medium „ „ 32 „ „
(4) The inferior „ „ 28 „ „

[*N. B.*—5 yavas=1 angula, according to Sukra.]

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[1] Sukra IV, vii, 830-31.
[2] Sukra I, 744.
[3] Sukra IV, vii, 145-8.
[4] *Vide* Law's *Hindu Polity*, p. 36.
[5] Sukra IV, vii, 86-89.

The limbs which are to have a fixed proportion with the face should have the following measurements:

(1) Stature[1] is to be 3 times face.
(2) Length " $4\frac{1}{3}$ "
(3) Girth or Circumference of belly 3 times face+3 angulas.

The measurements given by Sukrâcharyya differ from those given in Chânakya's *Arthasâstra*,[2] as well as in *Aswavaidyaka*.[3]

The classification of horses, according to general physiognomical features, has been elaborately treated under 50 heads by Jayadatta in the third chapter of his *Aswavaidyaka*. In his notes on this chapter, Pandit Umeshchandra Gupta has quoted passages from Nakula's veterinary science, *Agnipurâṇa*, *Brihat Saṃhitâ*, *Hârâvali*, *Amarakośa*, and *Hemachandra*, but specially from *Sukraniti*. The extracts show similarity as well as divergence of ideas on the subject.

The general characteristics of horses regarding features, colour, gait, &c., appreciated by Sukra authors are indicated below :—

(1) That horse is beautiful[4] which has a high neck and a low back.

(2) The horse[5] with divine attributes, or excellent horse is that which has a beardless face, beautiful, smart and high nose, long and high neck, short belly, heels and ears, very swift speed, voice like the cloud and the gander or swan, is neither wicked nor very mild, has good form or colour and beautiful circular rings of feather.

(3) The following horses are disparaged:

(i) those with black legs, or with one white leg,[6]

(ii) those rough, grey-coloured or ash-coloured,[7]

(iii) those with black roof of mouth, black tongues, black lips; or throughout black but with a white tail,

(iv) those with one white mark on the forehead, but throughout coloured otherwise—(called *Dalabhanji*),[8]

(v) those that throw kicks, make sounds with lips, shake their backs, tend to go down into water, suddenly stop in the midst of a movement, lie down on the back, move backwards and leap up,[9]

(vi) those that have snake-like tongues, the colour of bears and are timid in character,[9]

(vii) those with marks on the forehead disfigured by a minute blot (of another colour),[9]

(viii) those which tear asunder the ropes[9] (cf. IV, vii, 217).

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[1] Sukra IV, vii, 91-95.
[2] See Law's *Hindu Polity*, p. 38.
[3] Chapter III, 181-188, published in the *Bibliotheca Indica* Series.
[4] Sukra IV, vii, 144.
[5] Sukra IV, vii, 149-53.
[6] Sukra IV, vii, 225.
[7] Sukra IV, vii, 220-28.
[8] Sukra IV, vii, 234-35.
[9] Sukra IV, vii, 328-31.

(4) Defects of colour (whether one or variegated) are not considered, if the form be beautiful.[1]

(5) So also the presence of bad hair-marks on the body is not minded if the animal is strong, has a good gait, is well-formed, and not wicked.[2]

(6) The following movements of horses are appreciated:[3]

(i) with legs thrown from a height,

(ii) gait like those of tigers, peacocks, ducks, parrots, pigeons or doves, deer, camels, monkeys and bulls. *Aswavaidyaka* also bears this out.

(7) One of the most practical tests of good horses is given by Sukra; thus, if the horseman does not get tired by riding a horse even after over-feeding and over-drinking, the gait of the horse is known to be excellent.[4]

The value of horses in terms of money, *i.e.*, their prices, according to Sukra authorities, are given below:—

(1) The high prices for horses and elephants is 2000, 3000 or 4000. Now a silver pala=8 *tolas* or rupees. Therefore, the price is 16,000, 24,000, 32,000 rupees. This seems to be extraordinary, especially from the following estimation of the best horse. Hence, the figures 2,000, 3,000, 4,000, are to be taken to indicate not *palas*, but silver *tolas* or rupees.

(2) The best horse is that which can go 100 *yojanas* (500 or 700 miles) a day. Its price is 500 gold (coins) *i. e.*, Rs. 8,000.

The price of horses according to Sukra Statistics would, therefore, normally range from Rs. 2,000 to Rs. 8,000.

(*c*) *Omens.*

The third consideration which weighs much in the valuation of breeds of horses is the presence or absence of ringlets, curly-feathers, hair-marks, pimples &c on the body of the animal. These have been described thoroughly with all their significance in LXVI and XCIII chapters of *Brihat Saṃhitâ*, as well as the chapter on marks in *Aswavaidyaka* previously referred to.

According to the Hindus the marks are good or bad omens,[5] and may be interpreted to indicate the character, qualifications, disposition, as well as future social or economic condition of men over whose bodies they appear.

The science of omens relates to the animals also, and what is more, foretells adversity or prosperity of their masters. It is natural, therefore, that the subject was minutely studied in those days. Thus Varâhamihira begins his discourse on omens [6] with a short historical treatment of the science:

" Risabha has written a treatise on omens embodying the views of the

[1] Sukra IV, vii, 224, 236-37.
[2] Sukra IV, vii, 229-31.
[3] Sukra IV, vii, 238.
[4] Sukra IV, vii, 232-33.
[5] Varâhamihira has dealt with this topic in LV. of Brihat Saṃhitâ.
[6] Sukra IV, vi, Brihat Saṃhitâ, LXXXVI, 1-4.

gods Sukra, Indra, Brihaspati, Kapisthala, and Garuda, and of the Riṣis Bhâguri, Devala and others. Sri Devavardhana, the Maharaja of Avanti (Ujjayini) has written a treatise on omens, embodying the views of Bharadwâja. There are also treatises on omens by the seven Riṣis. Numerous treatises are also found on the subject written in ancient and modern languages. Then there are the treatises of Garga and others who have written works on Saṃhitâ. There are also treatises by writers who have written on Yâtrâ. Having examined all the above treatises, I proceed to write clearly this brief treatise on omens for the enlightenment of my pupils."

Our author has been referred to by Varâhamihira as an authority in the above bibliography. It appears Sukrâchâryya was a founder of this science. *Sukranîti* is perhaps the most elaborate of Niti-or Dharma-or Arthaśâstras in the treatment of the subject, as would be evident from the references given below. It should be mentioned that the Sukra authors, Varâhamihira, Nakula and Jayadatta do not all agree in the valuation or enumeration of the marks or omens connected with the features of horses.

The *bhramaras* or *âvartas, i.e.,* marks on the horses' body consisting of feather-curls or hairy growths may be (1) circular—like ringlets, or (2) of any shape and size, as indicated by the following substances :[1] Conch, wheel, mace, lotus, altar, seat of meditation, palace, gate, bow, pitcher full of water, white mustard seeds, garland, fish, dagger and Srivatsa gem.

These 16 are known to be auspicious signs. As for the circular ones, their significance, good or evil, is to be known from the following general rules:

(1) These may be (i) leftwards or rightwards, (ii) full or partial, (iii) small or large.[2]

(2) In the female horse, the leftward or anti-clockwise ring is auspicious ; in the male the rightward or clockwise.[3]

(3) The results vary also with the directions in which they are formed, *e.g.*, downwards, upwards or oblique ; [4] thus on the leg the downward mark is good, on the forehead the upward.[5]

These general remarks on hairy growths, whether circular or shaped like the objects enumerated above, have been the basis of a classification of horses according to merit. This is dwelt on more elaborately as below :

(1) *Excellent* horses[6] are those that have these marks on (i) nose-tip, (ii) forehead, (iii) throat, (iv) head.

(2) *Good* or *Middling*[7] horses are those that have such marks on (i) breast, (ii) neck, (iii) shoulder, (iv) waist, (v) navel, (vi) belly, (vii) front of the

[1] Sukra IV, vi, 159-11.
[2] Sukra IV, ii, 154-55.
[3] Sukra IV, vii, 156-57.
[4] Sukra IV, vii, 158.
[5] Sukra IV, vii, 212.
[6] Sukra IV, vii, 162-163.
[7] Sukra IV, vii, 164-5, 203-05. There is a repetition of waist and sides in the two references.

sides, (viii) back, (ix) lower lip, (x) space between ear and eye, (xi) thighs, (xii) forelegs.

(3) *Bad* horses[1] are those that have marks on (i) eyes, (ii) jaws, (iii) cheeks, (iv) breast, (v) upper lip, (vi) kidney, (vii) knee, (viii) genital organ, (ix) hump of the back, (x) right waist, (xi) right foot.

A few more good and bad marks are enumerated below :—

(*a*) *Good*:

(i) If two marks are noticed on the cheeks of a horse, they lead to the increase of the master's fame and territory.[2]

(ii) Two marks on the forehead with space between indicate good, and are like the sun and the moon. If they overlap, they give medium results.[3]

(iii) Three marks on the forehead with space between them, one being on the top, are indicative of good.[4]

(iv) One mark in the middle of the throat[5] is very auspicious and prevents all harms.

(v) On the leg the downward mark is good, on the forehead the upward.[6]

(*b*) *Bad*:

(i) The horse that has a mark on the left cheek is wicked and leads to loss of wealth.[7]

(ii) If the horse has marks in the mouth (or face?) or at the end of the belly, it is sure to get death or cause ruin of the master.[8]

(iii) The marks on knees give troubles of life abroad.[9]

(iv) The mark on the genital organ causes loss of[9] victory and beauty.

(v) The mark at the end of the vertebral column means total ruin.[9]

(vi) If on the forehead two marks be too contiguous, they are inauspicious.[10]

(vii) Three triangular marks on the forehead are causes of grief.[11]

(viii) The mark on the back of the genital organ or on the nipple or near the ear[12] is bad.

(ix) The horse that has an upward mark[13] on the leg is disparaged as the uprooter of posts.

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[1] Sukra IV, vii, 200-2. It has to be noted that there is a contradiction in this enumeration with that in 162-65 as regards navel, waist and throat.

[2] Sukra IV, vii, 174-75.

[3] Sukra IV, vii, 206-7.

[4] Sukra IV, vii, 208-9.

[5] Sukra IV, vii, 211.

[6] Sukra IV, vii, 212.

[7] Sukra IV, vii, 180.

[8] Sukra IV, vii, 191-2.

[9] Sukra IV, vii, 193-5.

[10] Sukra IV, vii, 207,209.

[11] Sukra IV, vii, 210.

[12] Sukra IV, vii, 214-15.

[13] Sukra IV, vii, 217.

(d) Breeds.

The artificial taxonomy of horses according to the adventitious marks on their bodies has created along with it a system of nomenclature also, which, according to Hindu tradition, again, is a good index to the quality, mettle and other characteristics of horses. In Sukranîti we have the technical names of the following classes or breeds :

(1) *Purnaharsa*[1]—with two marks on the brow and a third on the head.

(2) *Suryya*[2]—with a mark on the backbone—leads to the increase of master's horses.

(3) *Trikuta*[3]—with three marks on the forehead—leads to the increase of horses.

(4) *Vâjisa*[4]—with three marks on the neck—is the lord of horses in the royal stable.

(5) *Sarvanâma*[5]—with only one mark on the cheek—leads to the owner's ruin.

(6) *Siva*[6]—with a mark on the right cheek—leads to the happiness of the master.

(7) *Indra*[7]—with two spots on the ears—gives victory in wars and leads to happiness.

(8) *Vijaya*[8]—with marks on the nipples—gives victory in wars and leads to happiness.

(9) *Padma*[9]—with two marks on the side of the neck—brings several *padmas* (Padma = one thousand billions) of wealth as well as unceasing happiness to the master.

(10) *Bhupâla*[10] or *Chakravarti*—with one or three marks on the nose.

(11) *Chintâmani*[11]—with one large mark on the throat—leads to the realisation of the desired objects.

(12) *Sulka*[12]—with marks on the forehead and the throat—gives increase and fame.

(13) *Dhumaketu*[13]—with a mark at the origin of the tail—is ruinous.

(14) *Kritânta*[14]—with a mark on the rectum, the tail and the end of the vertebral column.

(15) *Ekarasmi*[15]—with a mark on one of the upper sides of the neck.

(16) *Panchakalyâna*[16]—with five white marks on the face and four legs.

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[1] Sukra IV, vii, 166-7.
[2] Sukra IV, vii, 168-9.
[3] Sukra IV, vii, 170-1.
[4] Sukra IV, vii, 172-3.
[5] Sukra IV, vii, 176-7.
[6] Sukra IV, vii, 178-79.
[7] Sukra IV, vii, 181.
[8] Sukra IV, vii, 182.
[9] Sukra IV, vii, 184-5.
[10] Sukra IV, vii, 186-7.
[11] Sukra IV, vii, 188-9.
[12] Sukra IV, vii, 190.
[13] Sukra IV, vii, 196-7.
[14] Sukra IV, vii, 198-99.
[15] Sukra IV, vii, 216.
[16] Sukra IV, vii, 219.

(17) *Aṣṭamangala*[1]—with the five white marks of Panchakalyâna, and three more white, *e.g.*, on the breast, neck and tail.

(18) *Śyâmakarṇa*[2]—with one colour throughout the body, but with ears coloured *śyâma* (*i.e.* greenish, swarthy, &c). If that one colour be white, the horse is sacred and deserves to be worshipped.

(19) *Jayamangala*[3]—with eyes like *vaiduryya* gem.

(20) *Dalahbanji*[4]—with one very white mark on the forehead, but coloured otherwise throughout—brings contempt upon the owner.

A classification of animals which has been adopted in the case of elephants has not been recorded by Sukra authors with reference to the horses. This has, however, been noticed in the Arthasâstra.[5] Thus, horses were regarded as belonging to the three classes or types of *tikṣṇa* (fiery), *bhadra* (gentle) and *manda* (sluggish).

It is also strange that Sukra authors should have omitted altogether a very important mode of economic classification of horses, *e. g.*, that according to their places of origin. The *Aswavaidyaka* has devoted a whole chapter[6] to this topic, called the chapter on *janmadesa* or Habitat or Zoological Distribution, as we would call it in modern times, and deals with the subject under nine heads: *e.g.* (1) good horses, (2) second-class horses, (3) worst-class horses, (4) *Tâjika* horses, (5) *Pârasîka* horses, (6) *Kekkana* horses, (7) *Turaska* horses, (8) *Bhândaja* horses, (9) *Saindhava* horses, &c.

The Arthasâstra,[7] also, mentions the following classes of horses, according to their natural habitats: (1) Kâmboja (Afghanistan) (2) Sindhu (Sindh) (3) Âratta (Punjab, according to Cunningham, p. 215), (4) Vanâyn (Arabia), (5) Bâlhîka (Balkh), (6) Sauvira (Eder in Guzrat, according to Cunningham, or Sophir of the Bible), (7) Pâpeye, (8) Taitala.

Of these places the first four were held to supply the best breed, and the remaining four the horses of the second quality. Horses of inferior quality came from other sources.

It may be mentioned here that almost all the places enumerated by Kautilya have been noted by Vâlmiki in the *Bâlakânda* of the Râmâyaṇâm (Canto VI, 22).

Trade in horses[8] seems also to have been a feature of South Indian commercial life in the 1st cent. A.D. Thus in the *Periplus* we have the description of Puhar, a port on the East coast, where "horses were brought from distant lands on the seas."

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[1] Sukra IV, vii, 220.
[2] Sukra IV, vii, 221-2.
[3] Sukra IV, vii, 223.
[4] Sukra IV, vii, 234-35.
[5] Law's *Hindu Polity* p. 36.
[6] *Vide* the 6th chapter of the work in the *Bibliotheca Indica* Series. This throws much light on the Economic or Commercial Geography of ancient India.
[7] Law's *Hindu Polity*, pp. 36-37.
[8] Aiyangar's *History of India*, p. 66.

(c) Training and Management.

Lt. General Sir Fitzwygram deals with the construction and ventilation of stables, stable fittings, watering and feeding, forage, grooming, shoeing, exercise, and stable management in part I of his work, "Horses and Stables." All these topics are the subject-matter of Jayadatta's *Aswavaidyaka* in several chapters, and have been described more or less in all Hindu treatises, called Arthsâstras or Nitisâstras, which have been handed down from at least the 4th century B.C.

It is, however, only during the last hundred years that, owing to the "enormous losses[1] produced by the ignorance of the true origin of disease, veterinary art has been recognised as second only in its usefulness to the care of human life." * * * "In the increasing value of domesticated animals useful to man, and in the greater ravages of disease, as must be the case where animals, more or less intended to roam at large, are crowded together ; as must be the case where land increases in value, and where also population increases in numbers and daily requires larger supplies of food ; in the increasing value and need of domestic animals, and in their increasing ailments arising from domestication, modern veterinary science has had its rise."

The humanity of the Hindus, as displayed in their care for animals since at least the 6th century B. C.—the epoch of the founders of Buddhism and Jainism—as well as the progress of their knowledge about ȧnimal-life, medical treatment of the dumb creatures, and the social, economic and political importance of Fauna, constitutes one more of the solid evidences regarding the great advance of the people of Hindusthan in spirituality and material civilisation, long before the "strong Son of God, immortal Love" flourished under the "Syrian blue." The unfounded remarks of Western scholars explaining away, without rhyme or reason, the antiquity of the original achievements of the Hindus in secular and physical sciences or arts, require, in the light of more rational and unbiassed investigations which they pretend to monopolise, only to be mentioned to prove their absurdity. It is strange that sentiments—for they are no better than sentiments—engendered by race-pride and colour-prejudice, like the following, expressed in the most categorical fashion and sweepingly general terms, should find a place in a scientific work like the *History of Mathematics*[2] published in the first decade of the 20th century :—

"The Hindus, like the Chinese, have *pretended*[3] that they are the most ancient people on the face of the earth, and that to them all sciences owe their creation. But it would appear from all recent investigations that these *pretensions*[3] have no foundation ; and in fact *no*[3] *science or useful art* (except a rather fantastic architecture and sculpture) can be traced back to the inhabitants of the Indian peninsula prior to the Aryan invasion. This invasion

[1] Fitzwygram's *Horses and Stables* (Longmans, Green & Co., London, 1911), Fifth Edition, pp. 512-519.

[2] By Ball (Macmillan & Co., London, 1908), Fourth Edition, p. 146.

[3] The *Itaics* are ours.

seems to have taken place in the latter half of the 5th century[1] or in the sixth century."

To return to the topics of horse training and management in *Sukraniti*. Sukrâchâryya says, as we have noted in a previous context: "The elephant, the horse,[2] the bull, the child, the wife, and the parrot get the qualities of their teachers through association." The staff connected with the management of horses consists of three classes[3] of men : (1) *aswâdhipati* or superintendent of cavalry, (2) *siksaka* or trainer, (3) the *sevaka* or groom. These, together with other items in the administration of the cavalry, will be treated of in the section on organisation of the Veterinary Department.

Some general observations[4] regarding forage, exercise, &c for horses are given below :—

(1) Defects grow in horses through long-continued absence of work. But through excessive work the horse grows lean and emaciated.

(2) Without bearing burden, the horse becomes unfit for any work.

(3) Without food, the horse becomes sickly, but with excessive feeding, it contracts disease.

(4) It is the good or bad qualifications of the trainer that give the horse good or bad gait.

We may compare these practical rules about grooming and training with those of a modern specialist[5] which apply especially to race-horses in India :

"(1) It is most important that the trainer should recognise the fact that he can greatly increase a horse's speed by practice.

" But experience teaches us that we must be very careful in applying the fact, that speed can be greatly increased by practice, to horses ; because, if we push it to an undue extent, they will be apt to become disgusted with their work, and may refuse to " try."

" (2) I am much averse from the plan of throwing sound, healthy horses altogether out of training during the summer, for hard condition once lost takes a long time to regain. A sound horse should get all through the hot weather a fair amount of healthy work.

"(3) The trainer, while supplying the horse with food suitable for the requirements of his system, when undergoing severe work, should never lose sight of the fact that the proper assimilation of such food can only be ensured as long as the functions of digestion are in a healthy state.

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1 What is the meaning of this date? This bit of recent investigation deserves a place by the notorious feat of Dugald Stewart in proving the Sanskrit language to be an invention of the crafty Brahmans !

2 Sukra III, 582-3.

3 Sukra II, 260-63, 270-73, 274-75.

4 Sukra IV, vii, 239-43.

5 Haye's *Training and Horse Management in India* (Longmans, 1905), pp. 150, 151, 164, 170, 172.

"(4) Horses should be made to walk smartly. Nothing looks slacker or causes an animal to walk in a more slovenly manner than the way syces often lead horses, with a long rein or rope over their shoulder, while they hobble along in front at the rate of about two miles an hour."

(f) Grooming.

The theory of grooming has been explained by General Fitzwygram[1] in his answer to the question—"why does the stabled horse require constant grooming, whilst the same horse turned out into a field does well enough without it?" "It is the work and the food, not the shelter," says he, "which constitutes the difference between the domesticated animal and the horse in a state of nature. * * * As long as the horse remains in a state of nature, taking only the exercise required for gathering his food, and feeding only on laxative diet, grooming is not needed, because the debris of the food and the excretions of the system are carried off mainly by the action of the bowels and the kidneys. The cart horse, whose work is slow, can get on with very little grooming. The hunter and the race horse, on the other hand, whose whole systems are developed to the utmost, require much more grooming than is necessary for carriage and ordinary riding horses. * * * Cavalry horses in camps require grooming just as much, and in some respects more than they do in barracks. * * * Grooming, or in other words, cleanliness of the skin, is not, as many suppose, a mere matter of appearance, or of a rough or smooth coat; but it is essential to the general health and condition of the domesticated animal."

It is remarkable that the Sukra authors, who have been writing mainly of the cavalry horses, should have been well-acquainted with the physiological aspects of grooming, as would be evident from the particular care they have insisted on the syces and servants in attending to the rations, health and comfort of the animals under their charge. The following rules of Sukrâchâryya about shampooing, washing, cleaning, &c., as well as feeding and exercise connected with the art of grooming, testify to their thorough grasp of the subject and may be compared with the most recent ideas about it.

(1) The horse that has got fatigue through work should be given a slight stroll for sometime, then should be fed upon sugar and powdered grains mixed with water.[2]

(2) The horse should be given *gur* (molasses) and salt just after work, before the saddle and fittings are brought down. Then when the sweat has disappeared, and it has stood calm and quiet the horse should be relieved of its fittings and reins.[3]

(3) The horse should be made to stroll in the dust after its limbs have been rubbed, and carefully tended with baths, drinks and foods[4].

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[1] *Horses and Stables*, pp. 66-7.
[2] Sukra IV, vii, 270-71.
[3] Sukra IV, vii, 275-78.
[4] Sukra IV, vii, 29-80.

(4) If the horse be made to carry burden, just after taking food and drink, it soon gets coughs, breathlessness and other diseases.[1]

General Fitzwygram[2] appreciates the Indian method of grooming in the following words:

"In India the native groom often cleans his horse by hand-rubbing or shampooing. The practice is good and has an excellent effect on the skin. It would be difficult, probably impossible, to get English grooms to adopt a practice so novel. But * * * the author believes the practice would be found most beneficial. The action of the hand never irritates the skin, which the brush frequently does."

(g) *Forage.*

We have just noted that according to modern Physiology and Hygiene feeding and grooming cannot be dissociated from each other and do in fact form two inter-connected functions of one and the same work, *viz.*, tending of domesticated horses. The treatment of food must inevitably come hand in hand with the other aspect of the general art of tending. It is perfectly natural, therefore, that rations of horses, and their cleaning, rubbing, washing, &c., have been dealt with by Sukra equestrians as an organically blended topic. Thus in the above remarks about grooming we have noticed also the treatment of the forage.

Besides sugar, salt, *gur* (molasses), and powdered grains or peas, called *saktu*, the varieties of horses' food are indicated in the following lines:

(1) The horse should be given peas or grains, mâsa, mungo (*phaseolus mungo*), both dry and wet, as well as well-cooked meat.[3]

(2) Wines and juices of forest or wild animals take away all the defects of horses.[4]

(3) The horse should be made to take milk, ghee, water and powdered grains.[5]

Sukrâchâryya thus recommends mineral, vegetable as well as animal food. The following order[6] indicates the varying degrees of nutritive rations known to our author:

(1) Best food—*e.g.*, Barley and pea.

(2) Second class—*e.g.*, Mâsa and makustha.

(3) Inferior stuff—*e.g.*, Masur and mungo.

The *Arthasâstra*[7] of Kautilya has given more elaborate rules about rations to be observed by the superintendent of horses. In the dietary for the best horse we find curd, milk, meat, among other articles.

The importance of sugar in the rations of horses is thus indicated by Hayes:[8] Cane sugar is the best of all restoratives for animals in a state of

[1] Sukra IV, vii, 283-4.
[2] *Horses and Stables*, p. 70.
[3] Sukra IV, vii, 272-73.
[4] Sukra IV, vii, 281.
[5] Sukra IV, vii, 282.
[6] Sukra IV, vii. 230.
[7] See Law's *Hind. Pol.* pp. 40-42.
[8] *Training and Horse Management in India*, p. 25.

exhaustion, because it can be absorbed into the system with little or no preliminary preparation by the digestive juices. Also the more tired a horse is, the more torpid are his disgestive organs. Therefore a solution of sugar is a far better restorative to a fatigued horse, supposing that the amount of sugar is equal to that of the starch in the gruel."

This explains the two rules of Sukrâchâryya about the kind of food to be administered to horses just after work. To appreciate the physiological significance of the rations prescribed in *Sukraniti*, Hayes' chapters on varieties of food, sketch of the theory of food and nutrition, watering horses, and practical rules for feeding and watering horses, should be read along with this section.

(h) Rules about exercise.

"As air is to the lungs or food to the stomach, so is exercise to the due development of the muscles, tendons, ligaments, and respiratory organs. In the horse, on account of the active exertions which we require from him, we wish to get the muscles as firm, the tendons and ligaments as strong, and the respiratory organs as vigorous as possible. * * * In the ox and sheep, and other animals which are used for food, we wish to have the flesh less firm and more tender ; and therefore we give him little or no exercise."

The above extract from Fitzwygram's work on Horses and Stables furnishes the theoretical considerations guiding the exercises of horses. It is evident that exercises would vary with the climate and seasons of lands. The rules of Sukra authors abcut the exercise of horses[1] according to seasons are given below :

(1) One should ride the horse in the morning and evening in *hemanta* (October and November), winter and spring, in the evening in summer, and in the morning in autumn.

(2) One should not use the horse in the rainy season nor on uneven grounds.

We have in the section on horticulture noticed the rules for watering plants adapted to the seasons, and had reasons for guessing that the rules indicated the conditions of life obtaining in Eastern India. In the present instance, also, the specially noticeable feature is the importance given to the rainy season, and this, again, probably points to the abundant rainfall in Eastern India.

The beneficial effects of exercise are thus described by Sukrâchâryya : "The appetite, strength, prowess, and health of the horse are promoted by well-regulated movements."[2]

The following are the rules for 'breaking' the horse :

(1) A circular breaking or training ground[3] has to be prepared. The circumference may be (i) 1,900 *châpas* or *dhanus* (=4,000 cubits), (ii) 500 châpas or 2,000 cubits, (iii) 1,000 cubits, (iv) 400 cubits, or (v) 200 cubits.

[1] Sukra. IV, vii, 266-68. In *Asvavaidyaka* a whole chapter has been devoted to the treatment of seasons.

[2] Sukra IV, vii, 269.

[3] Sukra IV, vii, 261-63.

(2) The movement or speed of the horse should be daily increased by exercises [1] within the circular ring in such a way that it can run 100 yojanas (400 or about 700 miles) in a day. This speed has been taken to be the criterion of the best horse in the calculation of prices [1] also. As for the daily increase of speed we have already noticed the theories of Sukra and Hayes.

(3) The ideal speed of horses is, again, indicated in the following rule, which, however, does not tally with the above :

"The good horse [2] should go 100 *dhanus* or 400 cubits in 16 mâtrâs." Horses are inferior according as the speed is lower." [As 10 mâtrâs=4 seconds, the rate given here would be about 64 miles an hour.]

(*i*) *The Art of Training.*

Feeding and grooming, the two parts of the work of tending horses, form the duty of the syce or groom. Exercise and Breaking also form part of his duty. But these aspects of horse-management may be conveniently left to the trainer or *sisksaka*; for he is responsible for the character, gait, paces, speed, &c., of the animal, which depend, to a considerable extent, on exercise, breaking, &c.

We have already noticed that "it is the good or bad qualifications of the trainer that give the horse good or bad gait ;" and we have just seen that the ideal speed which the horse should be expected to approximate is 64 miles an hour or 700—800 miles a day. The trainer must therefore be well up in the rules of horsemanship, which are given below :

(1) The good trainer is he who moves his legs below the knees, keeps his body erect, is fixed in his seat, and holds the bridle uniformly.[3]

(2) The good trainer should strike the horse at the proper place by whips mildly, and not too severely but with medium pressure.[4]

It is the proper use of the whip, in which, according to Sukrâchrâyya, consists the secrect of good horsemanship or success in jockey's art :—

(1) In the first place, one should never ride a horse without a whip,[5] and should overpower the animal by whips when necessary.

(2) In the second place, he must not use it indiscriminately or very often, or strike the horse at wrong places ; for then he adds to the defects of the animal, which last for ever.[6]

(3) The following are the rules for striking a horse :—(i) at the sides,[7] if it neighs, or if it slips, (ii) at the ear, if it shies, (iii) at the neck, if it goes astray, (iv) at the space between the arms, if angry, (v) at the belly, if absent-minded.

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1 Sukra IV, vii, 264-65. [A yojana=4, 5, 7, or 8 miles.]
2 Sukra IV, ii, 199.
3 Sukra IV, vii, 246-7.
4 Sukra IV, vii, 248.
5 Sukra IV, vii, 258.
5 Sukra I , vii, 244-45.
6 Sukra IV, vii, 255-57.
7 Sukra IV, vii, 248-50.

Or [1] (vi) at the breast, if it be terrified, (vii) at the neck, if it neighs, (viii) at the posterior, if it slips, (ix) at the mouth, if going astray, (x) at the tail, if angry, and (xi) at the knees, if absent-minded.

The function of the trainer[2] would thus appear to consist of the following classes of work :

(1) To promote the good disposition of the horse and maintain its proper mettle by skilful management, as just described.

(2) To qualify horses as swift racers by proper exercise, &c., as described in the previous sub-section.

(3) To train their gait, *i.e.*, teach them elegant paces according to the rules of military life, sportsmanship, hunting or ordinary riding.

Some of these paces were enumerated in the section on the general physiognomical and other features of horses ; *e.g.*, like those of tigers,[3] peacocks, ducks, &c. A few remarks about the gait and movements of horses have also been made there.

According to *Arthasâstra*[4] "horses were trained not only for the ordinary work of the state, but also for the more difficult movements required in war." The paces and trots enumerated by Sukrâchâryya differ, however, from those given by Kautilya, both as to name and description.

According to Sukra authors, movements are of 11 kinds :[5]

(1) *Chakrita*—circular.
(2) *Rechita*—galloping.
(3) *Valgita*—prancing.
(4) *Dhaurita*—trotting.
(5) *Âpluta*—jumping.
(6) *Tura*—speedy.
(7) *Manda*—slow or sluggish.
(8) *Kutila*—tortuous.
(9) *Sarpaṇa*—serpentine.
(10) *Parivartana*—rolling, revolving.
(11) *Âskandita*—galloping at full speed.

Of these, the following six[6] have been characterised by Sukrâchâryya thus—

(1) *Dhârâ*—which seems to be equivalent to *tura* in the above list—is known to be that pace which is very fast, in the midst of which a horse would get puzzled if spurred with the heels.

(2) *Âskandita*—that in which the horse contracts its forelegs and runs with rapid leaps.

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[1] Sukra IV, vii, 252-54.
[2] See also Sukra II, 270-73.
[3] Sukra IV, vii, 220-31.
[4] Law's *Hindu Polity*, pp. 42-44. See the technical terms used by Kautilya
[5] Sukra II, 270-73.
[6] Sukra IV, vii, 287-98.

(3) *Rechita*—that with short leaps, but continuous.

(4) *Pluta*—that in which the horse leaps with all the four legs like the deer.

(5) *Dhauritaka*—rapid movement with uncontracted legs very useful in drawing carriages or chariots.

(6) *Valgita*—that in which the animal runs with contracted legs, neck raised like that of the peacock, and half the body trembling.

(j) Stables and Trappings.

Sukraniti is silent about stables. We read only that horses are well-kept in watered lands,[1] and that stables for horses should be built in the northern side[2] of the palace. Kautilya deals with the subject very elaborately and treats of the ventilation, sanitation,[3] accommodation of the houses to be built for the horses.

As for the trappings, we have noticed them in connexion with grooming. One of the 64 Kalâs is the preparation of saddles[4] for horses, elephants, bulls and camels.

The instrument by which the horse is to be controlled is the bridle or reins, which has been elaborately described.[5]

For cleansing purposes an instrument with seven sharp teeth[6] is used.

SECTION 14.

Elephants.

In modern India elephants are used principally and solely as draught-animals. The following extract from Lieut-Colonel G. H. Evans' *Elephants and their Diseases*[7] would give an idea of the uses to which they are put:

"Elephants may conveniently be divided into two classes, namely,—(*a*) timber-elephants, (*b*) baggage or travelling elephants.

Timber-elephants, again, may be divided into two classes, namely, (i) trained tuskers, (ii) trained males and females.

Well-trained tuskers have at all times commanded a good price; they are much more useful, both in yards and forests, as with their tusks they can 'oung', *i.e.*, butt and stack timber, carry butts and planks, assist in getting logs over obstacles or in clearing blocks in creeks. * * * Though tuskers are largely employed in dragging operations, still most of such work is generally performed by tuskless males and females. Most Burmese elephants are trained to timber-work, and to some extent to carrying baggage."

In ancient and mediæval India, however, the elephant force constituted a special and characteristic feature of the Animal-corps. Alexander had to encounter on the Hydaspis a Hindu army which was remarkably strong in its elephant-force. Megasthenes' description of the capture of elephants is one of

1 Sukra IV, vii, 340-50.
2 Sukra I, 451-3.
3 Law's *Hind. Pol.*, pp. 38-39.
4 Sukra IV, iii, 194.
5 Sukra IV, vii, 341-44.
6 Sukra IV, vii, 346.
7 Pp. 7-8 (published by Superintendent, Government Printing, Burma, 1910).

the earliest pieces of literature on the subject.[1] "One of the four well-known divisions[2] of the old Hindu army was the elephant-force * * * There has been on record many a battle in early Indian history in which elephants carried the day."

It is not strange, therefore, that the animal should have drawn towards it the attention of Hindu poets, scholars, Ayurvedists, artists, politicians, &c., from the earliest times. We have already noticed the vast literature on the life, habits, medical treatment, &c., of elephants. It may also be noted that the elephant is very abundant in, and almost a characteristic fauna of, India. The abundance of the animal and its nearly uniform "distribution" throughout the land, account for the considerable uses made of it by kings in every part of the country and the impression made upon the thought of the people everywhere. Besides their distribution in present times along the foot of the Himâlayas as far west as Dehra Dun, forests between Gangâ and Krisṇâ, Western Ghats, Mysore, and Ceylon, "there is evidence[3] that about three centuries ago elephants wandered in the forests of Malwa and Nimar, while they survived to a later date in the Chanda district of the Central Provinces. At the comparatively remote epoch, when the Deccan was a forest tract, they were probably also met with there."

The rearing up of a good breed of elephants was recognised as one of the special cares of Chandragupta's Government. "The killing of an elephant was visited even with capital punishment."[4] Kautilya has treated the subject elaborately in *Arthasâstra.*

But Sukrâchâryya has paid more attention to horses than to elephants or the other animals in the army.

(a) Mettle and worth.

According to Hindu writers, the appreciation of elephants like that of horses depends on the following considerations :—(1) measurements of limbs, (2) certain external characteristics and internal temperament, (3) marks or omens, (4) places of origin. Sukrâchâryya has not touched the last two, and has dealt with the first two items very summarily.

The general physiognomical and other features of elephants that are much appreciated can be known from the following remarks :

(1) The best of all elephants[5] is one which has long cheeks, long eye-brows and long forehead, has the swiftest speed, and has auspicious marks on the body.

(2) Harmful elephants are those that have blue palates, blue tongues, curved tusks or no tusks, who persist long in their angry moods, whose rut gushes out without any systematic order, who shake their backs, who have less than 18 nails, and whose tails touch and sweep the ground.[6]

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[1] Book III, Fragment XXXVI.

[2] Law's *Hind. Pol.*, p. 47.

[3] *Encyclopædia Britannica*, 11th Edition, Vol. 9, p. 260.

[4] Law's *Hind. Pol.*

[5] Sukra IV, vii, 83-84.

[6] Sukra IV, vii, 64-67.

A modern writer[1] on the subject enumerates the following points of a good elephant which may be compared with those given by the ancient Hindu author: medium height, a good big barrel, skin soft and wrinkled (described by Burmans as crocodile skin), the head massive, full cheeks, and a broad forehead; the ears large, eyes bright and kindly, and free from opacity or excessive flow of tears; the trunk of good length, broad at the root, and blotched in front with pinkish coloured spots. The neck short, thick and full; chest broad, the back straight and broad, broad loins; short forelegs, convex in front (*i.e.*, set up like a lion). The hind quarters full, sloping well down and supported by thick short limbs. The pads of the feet hard, nails smooth and polished, action free, paces fast and easy; the tail should be of good length, free from hardness, and provided with a good tuft of bristles."

The tests of Varâhamihira of the 6th century A. D. are given in the following lines taken from the 67th chapter of *Brihat Saṃhitâ*,[2] called 'characteristics or features of elephants':

(1) "The elephant whose lips and mouth are red, whose eyes resemble those of the sparrow, whose tusks are shining, grow upwards and have sharp ends, whose face is large and long, whose backbones are like bows, long and invisible, whose *mastakas* (round protuberances on the temples) are covered with hair and resemble the turtle, whose ears, mouth corners, navel, forehead, and genital organs are large, whose body resembles the turtle, whose nails are 18 or 20, whose trunk has three lines and is round, whose tail is beautiful, and whose juice (when in rut) is felt to be of good smell when the animal blows through its trunk, will bring on wealth.

(2) The elephant whose tail is long, trunk red, roar like that of clouds, and neck large, long and round, will bring wealth to a king.

(3) Non-rutting elephants, those which possess extra or defective organs, those which are lame or short, or whose tusks resemble the horns of the sheep, whose testicles are visible, those which possess little or no trunk, whose mouth corners are brown, blue, black, or of different colours, those which possess very little hair about the face, those which have no tusks, those which have no virility, female elephants possessing the features of a male elephant produce misery."

These and sundry topics of economic importance in connection with elephants have been dealt at length in the 36th chapter of Book IV of Sivadatta's *Pâlakâpya*.

Hindu tradition, as we have just seen, attaches much importance to the number of nails. The following remarks of Evans throw much light on this question: "Some animals have four nails on each foot; this decreases their value, as five nails on each foot raises the same; four on each of the front feet and five on the hind ones does not interfere with their value. Out of a total of

1 Evans: *Elephants and their Diseases*, pp. 8-10.

2 Iyer's *Brihat Saṃhitâ*, Part II pp. 98-99.

62; Indian, Burmese, and Siamese elephants, only three possessed twenty nails[1] $\frac{5-5}{5-5}$, 500 had eighteen $\frac{5-5}{4-4}$, 104 sixteen $\frac{4-4}{4-4}$, and 16 seventeen toes $\frac{5-4}{4-4}$."

It would appear, therefore, that the very fact of 18 and 20 nails being rare has had something to do with the worth of animals among the Hindus. We incidentally notice here the minute observation of limbs and other features of animals that was a characteristic of Hindu intellect.

(*b*) *Omens.*

The auspicious marks have been referred to in *Sukraniti*, but have not been described. The *Brihat Samhitâ* has enumerated some of the omens connected with elephants which may be interpreted to indicate prosperity or adversity of the owners. A few remarks apply equally to horses and elephants. Certain special points applying only to the latter, *e.g.*, those connected with the cutting, breaking, etc., of the tusks are being given below :[2]

"(1) If the cut be white, smooth, glossy and emitting good scent, there will be prosperity. All that I now proceed to state about the breaking of tusks applies also to the dropping down, becoming thin and loss of colour.

(2) "If the elephant be found to walk unsteadily, if its ears cease to move, on a sudden, if the animal be of dejected appearances or if it be found to put its trunk to the ground or to breathe softly and long, if the eyes be full of tears, if the animal be found to sleep always or to be restive or to refuse to eat properly, or to pass excrement or urine often, there will be misery."

Burmese tradition on the subject has been recorded by Evans in *Elephants and their Diseases.*[3] "The following peculiarities in some animals reduce their value, as they are regarded with superstitious dread by the Burmese. It is thought that the ownership of such creatures may cost their masters loss of life or substance:

(1) A loose fold of skin, descending from the throat down to the forelegs."
(2) Moving head up and down and simultaneously from left to right.
(3) Swinging the trunk only to the left and right.
(4) Restlessness of the whole body somewhat after the fashion of bears.
(5) Holding the trunk up in the air and putting it into the mouth."

(*c*) *Breeds.*

The *Hastisâstras* have handed down various systems of taxonomy, both economic and more or less zoological. In *Sukraniti* we have only one system of terminology and classification. "There are four classes[4] of elephants in order of merit:

(1) *Bhadra*—(*a*) "that which has tusks coloured like honey (*i.e.*, not

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[1] *Elephants and their Diseases*, p. 12.
[2] Iyer's *Brihat Samhitâ* Part II, pp. 212-13.
[3] Pp. 11-12.
[4] Sukra IV, vii, 68.

pure white, but yellowish, which is strong and well-formed, is round and fat in body, has good face and excellent limbs ; "[1] (*b*) "the height[2] or stature is seven cubits, length eight cubits, and girth or circumference of the belly ten cubits."

(2) *Mandra*—(*a*) "that which has a fat belly,[3] lion-like eyes, thick skin, thick throat and thick trunk, medium limbs, and a long body ;" (*b*, height[4] six cubits, length eight and girth nine.

(3) *Mriga*—(*a*) "that which has small or short throat,[5] tusks, ears and trunk, big eyes, and very short lips and genital organ, and is dwarf ;" (*b*) height five cubits,[6] length seven cubits and girth eight cubits.

(4) *Misra*—(*a*) "that which has these[7] characteristics in mixture,"—*i.e.*, a non-descript, incapable of being specified as belonging to a particular type, (*b*) no measurements given.[8]

It would appear that the 'artificial' classification given here is meant only to indicate by technical terms the permutation and combination of external characteristics previously mentioned.

Varāhamihira also recognises these four classes of elephants in Chapter LXVII, but describes them in a slightly different[9] manner. The second class is called by him *manda* and not *mandra*, and the last *sankirṇa* and not *miśra*. The measurements given by him agree with those in *Sukraniti* except in the following rule recorded by the latter :—" But it is mentioned[10] by sages that the lengths of the mandra and bhadra class would be equal." The additional information in *Brihat Saṃhitā* is about colour of the animals :—

(1) The *Bhadra* is of green colour and is a rutting animal.
(2) The *Mandra* is of yellow colour.
(3) The *Mriga* is of black colour and is also a rutting animal.
(4) The *Sankirṇa* is of mixed colour and a rutting animal.

About the height of elephants[11] Evans makes the following remarks :—

" Extravagant estimates of the height of elephants have from time to time been recorded ; their great bulk so far exceeds that of the ordinary animals we are accustomed to see that the tendency is to overestimate their size. The old method of measuring was also most misleading : a rope was simply thrown over the back, the ends brought to the ground on each side, and half the length taken as the height. Much amusing information on this subject is contained in Sanderson's excellent work. Madras elephants, he tells us, were at one time

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[1] Sukra IV, vii, 69-70.

[2] Sukra IV, vii, 79-80. [*N.B.*—In elephant measurements, 8 yavas=1 angula.
24 angulas=1 kara or cubit.
In horse-measure, 5 yavas=1 angula.
Sukra IV, vii, 77-8, 85.]

[3] Sukra IV, vii, 71-72.

[4] Sukra IV, vii, 81-82.

[5] Sukra IV, vii, 73-74.

[6] Sukra IV, vii, 81-82.

[7] Sukra IV, vii, 75.

[8] Sukra IV, vii, 76.

[9] See the original Sanskrit Text in the *Bibliotheca Indica Series*, edited by Kern (Calcutta, 1865), pp. 338-40

[10] Sukra IV, vii, 82

[11] *Elephants and their Diseases*, pp. 4-6

said to be from 17 to 20 ft. high, and an animal of Dacca was said to be 14 ft. Mr. Corse, a gentleman thoroughly conversant with elephants * * * was rather surprised to find that according to his measurement the animal said to measure 14 ft. did not exceed 10 ft. in height (a very good height). We may take it on the authority of Sanderson * * * that such a thing as an elephant measuring 10 ft. at the shoulder does not exist in India, nor may I add, in Burma. The largest male he ever met with measured 9 ft. 10 in. and the tallest female 8 ft. 5 in. * * * Of 300 elephants measured in this Province the average height was 7 ft. 10½ in. * * All these animals were measured at the shoulder as is done with horses."

It is evident from the above that the Indian method of measuring heights is different from that of measuring animals at the shoulder. Therefore, the extraordinary height attributed to Indian elephants by people as well as scholars of Hindusthan, is quite natural and perfectly explicable, and in fact does very well tally with the statistics recorded in modern times. According to the Hindu authorities the *bhadra* or the best class attains a height of 7 cubits or 10½ ft., and the *mriga* or ordinary class has a stature of 5 cubits or 7½ ft., and this, measured not by the new method, but the old Indian method. If the heights of the old method be reduced to the new standard, the Bhadra would be very much under 10½ ft. *i.e.*, about 8 or 9 ft.; and the Mriga would be about 5 or 6 ft. We should therefore be inclined rather to think that the Hindu writers have understated the highest stature attainable by elephants; for, as we have just seen, the Dacca elephant measured 10 ft., and the average elephants measure generally 7 ft. 10½ in.; *i.e.*, the ordinary animals are equal to the highest classes mentioned in the standard Sanskrit works on elephants.

Abul Fazl records the Hindu tradition of the four classes of elephants in the *Ayeen Akbari*,[1]—that Imperial Gazetteer of India in Moghul times:

"The natives of Hindusthan hold this animal in such estimation that they consider one of them as equivalent to 500 horses. * * * The price of an elephant is one hundred to a lac of rupees. Those of five thousand, and of ten thousand rupees price, are not uncommon. * * *

There are four kinds of elephants. *Behder* (Bhadra) is that which has well-proportioned limbs, an erect head, broad breast, large eyes, and a long tail, with two excrescences in the forehead resembling large pearls. These excrescences are called in the Hindovee language Guj Manik, and many properties are ascribed to them. Another kind called *Mund* (Mandra) has a black skin, and yellow eyes; is bold and ungovernable. That called *Murg* (Mriga) has a whiter skin, with moles, and its eyes are of a mixture of red, yellow, black and white. That called *Mirh* (Misra) has a small head, and is easily brought under command: Its colour is a mixture of white and black, resembling smoke. And from mixtures of the above kinds are formed others of different names and properties."

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1 Part I pp. 146-147 (Translation published in 1783).

It should be remarked that Kautilya's *Arthasâstra* does not enumerate these four classes; his silence may probably be taken to mean the absence of the idea in the 4th century B.C. But the *Yukti-kalpataru*, also, a work later than *Brihat Samhitâ*, which treats of elephants, horses, cattle, &c., and mentions the eight classes of elephants called *Diggaja*, *e.g.*, *Airâvata*,[1] *Pundarika*, &c., with their characteristics as well as the four classes, *e.g.*, Brahmana, Kṣatriya, &c., does not record the four-fold distinction noted in Sukraniti and Brihat Samhitâ. So the mere silence of Kautilya is no evidence against the absence of the tradition in his times.

The number four seems to have been a favourite with Hindu authors in thinking of classes. For corresponding to the four castes in social life we have four classes of elephants and also four classes of wood. Thus "according to the *Brikṣa Ayurveda*[2] or the Science of Plant-Life (Botany) four different kinds of wood are to be distinguished: the first or the *Brahmana* comprises wood that is light and soft and can be easily joined to any other kind of wood; the second or the *Kṣatriya* class of wood is light and hard, but cannot be joined on to other classes; the wood that is soft and heavy belongs to the third or *Vaisya* class; while the fourth or the *Sudra* class of wood is characterised by both hardness and heaviness."

The classification of breeds according to the places of origin has not been mentioned in *Sukraniti*, but recorded by Kautilya: "The sources of supply of elephants[3] were the following places: (1) Kalinga, (2) Anga, (3) Karusa (eastern portion of the district of Shahabad in Behar) supplying elephants of the best quality;

(4) Prâchya (east), (5) Dasarṇa (modern Mandasore), (6) Aparanta (western countries, *viz.*, Konkan and Malabar), supplying elephants of medium quality;

(7) Surâstra (Guzrat) and (8) Panchajana (in Northern India), supplying elephants of inferior quality."

The following extract from the *Ayeen Akbari* would also furnish information regarding some aspects of the Economic or Commercial Geography of Mediæval India: "Elephants are taken in the following places. In Agra, in the wilds of Begavan, and Nerwar, as far as Berar. In the Subah of Allahabad; near Ruttenpoor; Sirgetchch; the Subah of Malwa; Hattendeyah; Achowd: Chundary; Suntwass; Bijegurh; Roysan; Hosengabad; Gurh; Haryegurh; in the Subah of Behar on the Borders of Rohtas; at Jharkhend; and in the Subahs of Bengal and Orissa, particularly at Satgong, there are great numbers. The best elephants are those of Tipperah."

[1] Two of these eight names have been referred to in Sukra II, 256–58

[2] *History of Indian Shipping* (Longmans, Green & Co.), 1912 by Prof. Radhakumud Mookerji, p. 20.

[3] Law's *Hindu Pol.* pp. 50-51.

The money-value of elephants, according to the statistics supplied by the Sukra authors, is indicated below :

(1) Good elephant[1] (or horse) costs 2,000, 3,000, or 4,000 rupees.

(2) The elephant[2] that is unrivalled in strength, height, fight and *mada* (rut) is priced at 2000 *niṣkas* [Niṣka is the value of gold weighing 4 *māṣās*; and in estimating the value of elephants, 5 *ratis* = 1 *māṣā*] or Rs. 6,666.

We have already noticed the remarks of Abul Fazl about the high prices of these animals. Evans' remarks on Prices are given below: "Prices vary according to age, good points, temper, training, and length, thickness, and sweep of the ivory. * * * A full-grown well-trained tusker will command as much as Rs. 7,000 and a well-trained female as much as Rs. 5,000. Elephants that are trained to baggage work or slightly to timber may cost Rs. 4,000." These are known to be high prices.

(d) Training and Management.

Information in Sukraniti regarding the rations, grooming, exercise, training, medical treatment, stabling, &c., of elephants is very scanty, almost nothing. Some of these items have been but casually noticed, as we have seen previously. Thus we read: (1) One should bring friends and foes to submission by appropriate methods as snakes, elephants and lions are tamed.[3] (2) The elephant, the horse, the bull, the child, the wife and the parrot get the qualities of their teachers through association.[4]

The art of training has been mentioned among the subjects that should be studied by the man who is to be in charge of elephants.[5] We have also read previously of professions connected with the capture of the animals. There are two *kalâs*[6]—one relates to the driving or guiding, and the other to the teaching or training.

The *Arthasâstra*[7] gives more details. About capture of the animals we are told that the captors, taking with them five or seven female elephants roamed about in the summer—the season for the capture of elephants—in the forest, and traced the whereabouts of herds of elephants by folllowing the course of their dung and urine, and by observing their footmarks, the spots where they reposed, the banks of rivers, lakes, &c., they damaged.

Kautilya divides elephants into four classes according to their training:

(1) *Damya*—those that are being trained.

(2) *Upavâhya*—those trained for riding, &c., in times of peace.

(3) *Sânnahya*—trained for war.

(4) *Vyâla*—refractory and difficult to be broken, because of obstinacy, perversity, bad temper, &c.

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[1] Sukra IV, ii, 198.
[2] Sukra IV, ii, 203-6.
[3] Sukra IV, i, 48-49.
[4] Sukra III, 582-3.
[5] Sukra II, 250-9.
[6] Sukra IV, iii, 160.
[7] Law's *Hind. Pol.* p. 51-7.

There were several clearly marked out stages in the process of taming. For war purposes the elephants were taught seven kinds of movements ; for riding they were taught eight movements. The movements for military purposes are :—

(1) *Upasthâna*—rising, bending, jumping over fences &c.
(2) *Samvartana*—turning.
(3) *Samyâna*—moving forward straight or transverse or making serpentine movement.
(4) *Vadhavadha*--killing and trampling down.
(5) *Nâgarayana*—assailing forts and cities.
(6) *Hastiyuddha*—fighting with other elephants.
(7) *Sângrâmika*—other cognate movements relating to war.

The elephant is governed by the hook[1] which has two teeth, one for movement forward, and the other for movement backward.

About stables Sukrâchâryya says nothing. We are only told that elephants are well-kept in forests.[2] The sixth chapter of the 4th Book of *Pâlakâpya* describes in prose the nature of the soil, the direction, the size, shape, doors, &c. of the stables suitable for elephants : and the 5th chapter of the second Book advises great precaution in allowing visitors into the *hastisâlâs* for fear they might cause damages to the animals by administering poisons, &c. The effects of poisons on various substances, animals, milk, fire, &c., are treated here quite elaborately. In connexion with the housing arrangements should be noted also the religious ceremonies for the propitiation of the gods described in the last two chapters of the Book IV.

Kautilya's treatment of stables[3] in the Arthasâstra is full enough. " There were two sets of stables, one in the fort, and the other outside ; in the former were kept those animals that had already been trained for war and riding, and in the latter those that were being trained, together with the refractory animals.

An elephant stable was twice as high as the length of an elephant, and its width was half its height ; it was made to face either the north or east, had separate apartments for female elephants, had a spacious corridor, &c."

SECTION 15.

Bulls and Camels in Sukraniti.

The celebrated Sanskrit manuscript, called *Yukti-kalpataru*, has several sections devoted to animal-life. Three of these relate to Bulls and Cows, their character, merits and defects. There are two methods of classification adopted in this treatise with regard to Bulls : (1) into Brahmanas, Kṣatriyas, Vaisyas and Sudras, and (2) into Sâtwika, Râjasika and Tâmasika.

Information supplied by Sukra authors is very meagre. We read—

(1) Bulls get the qualities of their trainer through association.[4]

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[1] Sukra IV, vii, 339-40.
[2] Sukra IV, vii, 940-50.
[3] Law's *Hindu Pol.* p. 51.
[4] Sukra III, 582-3.

(2) The price of a bull[1] with good horns, fair colour, sufficient strength, which can carry burdens and can walk fast, and which has the height of eight tâlas is Rs. 480.

(3) The bull is controlled by the string which passes through the nose.[2]

(4) Bulls are well-kept in watered lands.[3]

Regarding camels we are told—

(1) The high price of camels is known to be that of the buffalo,[4] *i.e.*, Rs. 56 or Rs. 64.

(2) The good camel[5] is one which can go 30 yojanas (120 or 210, or 240 miles in one day. Its price is 100 silver palas or Rs. 800

(3) The camel, like the bull, is governed by the strings.[6]

(4) Camels, like elephants, are well-kept in forests.[7]

The following are the remarks of Abul Fazl about camels :

"From the encouragement given by His Majesty, there are now bred in Hindusthan camels that excel those of Turan and Iran.

"A number of these animals are selected, and always kept ready to fight for diversion. The head *Khaseh* camel, named *Shah Pussend* (the king's choice), and who is a native of Hindusthan, has for the space of 12 years conquered all antagonists.

"Camels are bred in the following places : Ajmere, Judhpoor, Nagore, Beyganur, Jalmeer, Hetinda and Tahresir ; and in the Subah of Gujrat, near the province of Kutch are great numbers and very fine. But in Sind are the greatest abundance. The swiftest camels are those of Ajmere, the best for burden are bred in Tatah" * * * Camels do not live above 24 years."

The *Ayeen Akbari* gives details about the daily rations of camels according to age, their furniture, methods of training and anointing them, the administrative staff in connexion with this branch of Imperial live-stock, and prices, etc.

The Hindus had been for ages skilled in the training and management of camels. And it appears that the camel-post was one of the Moghul institutions for the conveyance and transmission of news : "Reybary is the name given to a tribe of Hindus, who are skilled in the management of camels. They teach the Hindu Look (species of camel) to travel at a great rate. Although for the speedy conveyance of intelligences postmen are stationed at every five *cose* (10 miles) from one extremity of the empire to the other, yet a great number of these camel riders are continually in waiting at the palace to carry order."

About Bulls the *Ayeen Akbari* gives the following information : "Throughout Hindusthan the ox is esteemed lucky and held in great veneration. Every part of the empire produces good oxen, but those of Gujrat are

[1] Sukra IV, ii, 194-195.
[2] Sukra IV, vii, 345.
[3] Sukra IV, vii, 349-50.
[4] Sukra IV, ii, 198.
[5] Sukra IV, ii, 201-2.
[6] Sukra IV, vii, 345.
[7] Sukra IV, vii, 349-50.

esteemed the best. These will travel 36 miles in the course of 24 hours, and they are swifter than the generality of horses. Sometimes a pair of them are sold for 100 mohurs, but they are very commonly of 10 and 20 mohurs. There are also abundance of fine oxen in Bengal and the Deccan, that will kneel down to be loaded. Many cows at Delhi give daily 20 quarts of milk each, and are sold for more than 10 rupees. His Majesty has a pair of bullocks which cost 500 rupees. In the neighbourhood of Tibet and Kashmeer, are the Katars, which are of a very extraordinary appearance. This animal lives seldom above 25 years.

SECTION 16.

The Anatomy of the Vertebrates.

(*a*) Hindu Literature on Human Anatomy.

Like mineralogy, Botany, and Zoology, the Anatomy of the Hindus lies scattered through all branches of Hindu literature, Vedic, Paurāṇic, Tāntric, Medicinal, Astronomical, and Sociological.

The Hindus have described five hundred muscles,—four hundred in the extremities, sixty-six in the trunk, and thirty-four in the region above the clavicle. They knew of the ligaments, sutures, various vessels and nerves, lymphatics and nerve plexuses, seven layers of skin, Mānasadharā or Fascia, Medhadharā or Adipose tissue, Raktadharā or Vascular tissue of blood vessels, Pittadharā or Mucous membrane of the digestive canal, Sleṣmadharā or Synovial membranes, etc. There are allusions to Vapā (pericardium), Hridaya (heart), Fusfusa (lungs) Yakrit (liver). Pliha (spleen), Vrikka (kidneys), Mastiskam (brain), Adhipati (medulla),[1] etc.

Any tubular structure is called by them a *nâdi* or vessel. But they distinguish three sorts of *nâdis*: (1) Dhamani (artery) carrying wind, (2) Sirā (vein) carrying blood, (3) Srota (canal), including the large and small intestines, ducts of the various glands, lacteal vessels, etc.

1. *The Nervous System of the Tantras.*

The contributions of the Hindus to anatomy are recorded in many non-medical works,—*e.g.*, the Tantras—the last phase of Yoga philosophy in India—the records of Hindu culture in mediæval times. It is only very recently that the Tantras have begun to be edited and translated.[2] But in 1885 one of these documents of Hindu allegorical literature and mystical lore, *viz.*, the *Shiva Saṃhitâ*, was translated into English by Rai Bahadur Srischandra Basu.

In his Prize Essay on the Hindu System of Medicine published in the *Guy's Hospital Gazette* of London (1889), Major B. D. Basu, I.M.S., referred to the anatomy of the Tantras in the following words: "When these Tantras

[1] The Ayurvedic System of Medicine by Dr. Sumant B. Mehta of Baroda (Navsari, Bombay, 1913), and Dr. Gananath Sen's Medical Science in Ancient India (Sâhitya Sabhâ, Calcutta, 1908).

[2] See the *Tantrik Texts Series*, edited by Avalon, and *Mahânirvâṇa Tantra* translated previously by Manmathanath Datta, recently revised by Avalon (Luzac & Co., London, 1913.)

will be studied by oriental scholars, as closely as they have explored other branches of Sanskrit learning, the anatomical knowledge of the ancient Hindus shall be better known to the world ; " for, according to him, " better anatomy is given in the Tantras than in the medical works of the Hindus."

From *Shiva Saṃhitâ* now republished in the "Sacred Books of the Hindus Series," we learn that the Hindus were acquainted with the spinal-cord and the brain. They knew that the central nervous system is composed of grey and white matters. They discovered the central canal of the spinal cord, and traced its connexion, through the fourth and third ventricles, with the lateral ventricles of the brain. They call it *Brahmarandhra*, or the dwelling-house of the human soul. The same Tantric work gives a description of the several ganglia and plexuses of the nervous system. The brain is said to be composed of *Chandrakalâ*, or convolutions resembling half-moons.

The nervous system of man is in fact more accurately described in the mystical Tantras than in purely medical treatises. In a paper on the Anatomy of the Tantras, originally published in the "Theosophist" of March 1888, and reprinted in the Introduction to Shiva Saṃhitâ in the Sacred Books of the Hindus Series, Major Basu has tried to unravel the mystery of the Yogis and Tântrists regarding the nerves and nerve-centres, and identify the *Nâdis*, *Chakras*, and *Padmas*. The following is a reproduction from that paper.

The language of the Tantras being too allegorical and too mystical to be understood by the uninitiated, it is very difficult to identify the Nâdis, the Chakras, and the Padmas described in them.

However, some of the spots are easily identifiable from their simple and lucid description. Thus it is apparent that the "nectar-rayed moon" (*vide* Shiva Saṃhitâ, Ch. II, verse 6) is the underpart of the brain ; that "Suṣumna" is the spinal cord ; "Idâ" and "Pingalâ" are the left and right sympathetic cords respectively.[1]

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[1] The Uttar Gitâ has thus described the relations of these structures (Ch. II, verses 14 and 15) :—

"The bony column that extends (from the coccyx) to the occiput is called the Brahmadanda (*i.e.*, the vertebral column). Within this is the thin cord Suṣumnâ, which is also called Brahmanâdî by the wise. This Suṣumnâ is midway between the Idâ and Pingalâ."

Another Tantric work named, Ṣat-Chakra Nirûpaṇam, has thus described the position of these three Nâdis :—

"Outside the spinal canal, on the left is the Idâ and on the right is the Pingalâ, while within the canal and midway between the above two Nâdis is the Suṣumnâ, whose structure is like a rope."

Prof. Cowell identifies Suṣumnâ with the coronal artery (*vide* his translation of Maiteyi-opinishad, p. 270, footnote. Published by the Asiatic Society of Bengal.) While Pandit Rama Prasad Kasyapa, M. A., identifies Suṣumna with trachea, and Idâ and Pingalâ with left and right bronchi (Occult Science, the Science of Breath. Published at Lahore, 1884).

But it is clear from the above description that these three famous Nâdîs are the spinal cord and the two sympathetic cords.

We shall try now to identify some of the nervous structures described in the Tantras :—

"Chitra."—From the description of this Nâdî in the Tantras (Shiva Saṃhitâ, Ch. II, verses 18-19), it may be identified with the grey matter of the spinal cord. For "in it is the subtlest" of all hollows called "Brahmarandhra," which is nothing else save the central canal of the spinal cord—a structure whose functions remain as yet to be discovered by the physiologists. The Tantrists appear to have traced its connection with the lateral ventricles of the brain. It has been considered by them to be the seat of the human soul. Even in these days, when it is no exaggeration to say that the Hindus have quite forgotten the scientific truths discovered by their ancestors, they point to the hollow space in the crown of the head (known as the anterior fontanalle) of the new-born child as the Brahmarandhra.

Every tyro in anatomy knows that this space contains the lateral ventricles of the brain.[1]

The "Sacred Triveṇî" (Shiva Saṃhitâ, Ch. V, p. 52) is the spot in the medulla oblongata where the sympathetic cords join together or whence they take their origin. (*Vide* Ashby's Notes on Physiology,—Article Medulla Oblongata). The mystic Mount Kailâsa (Shiva Saṃhitâ, Ch. V, p. 154) is certainly the brain.

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1 Prof. Sir Monior Williams has defined Brahmarandhra to be "a suture or aperture in the crown of the head and through which the soul is said to escape on death." (Sanskrit-English Dictionary.) Now the learned professor's definition explains nothing. Had he consulted the Tantras and known the space called the Brahmarandhra by the modern Hindus, we doubt not his conclusion would have been the same as ours (*i.e.*, he would have identified the Brahmarandhra with the central canal).

2. A Hindu renegade thus delivored his verdict on the anatomy of the Tantras, &c. :

"It would indeed excite the surprise of our readers to hear that the Hindus, who would not even touch a dead body, much less dissect it, should possess any anatomical knowledge at all............................ It is the Tantras that furnish us with some extraordinary pieces of information, concerning the human body........... But of all the Hindu Sâstras extant, the Tantras lie in the greatest obscurity..The Tantric theory on which the well-known Yoga called "Shat-chakra-bheda" is founded, supposes the existence of six main internal organs, called Chakras or Padmas, all bearing a special resemblance to that famous flower, the lotus. These are placed one above the other, and connected by three imaginary chains, the emblems of the Ganges, the Yamunâ and the Saraswati............

"Such is the obstinacy with which the Hindus adhere to these erroneous notions, that even when we show them by actual dissection the non-existence of the imaginary Chakras in the human body, they will rather have recourse to excuses revolting to common sense, than acknowledge the evidence of their own eyes. They say with a shamelessness unparalleled, that these Padmas exist as long as a man lives, but disappear the moment he dies."—Physical Errors of Hinduism, Calcutta Review, Vol. XI, pp. 436-440.

A Daniel has come to Judgment. Did the Hindu renegade take the trouble to compare the Chakras with the Plexuses of modern Anatomy? Had he done so, he would not have talked such nonsense. His paper contains two diagrams, one of the six Chakras and the other of the different viscera as represented by the modern Tântrists,

Padmas and Chakras.—Great difficulty arises in identifying these Padmas and Chakras. What are these structures one is tempted to ask? Are they real, or do they only exist in the imagination of the Tântrists? Though we are unable to satisfactorily identify them, we nevertheless believe that the Tântrists obtâined their knowledge about them by dissection. These terms have been indefinitely used to designate two different nervous structures, *viz.*:—nervous plexuses and ganglia. But it may be questioned, how are we authorized to identify the Tantric Padmas and Chakras with either the ganglia or plexuses of the modern anatomists? Our reasons for doing so are the following:

1st.—The position of some of these Padmas and Chakras corresponds with that of the plexus or ganglion of the modern anatomists.

2nd.—These Chakras are said to be composed of petals designated by certain letters, which clearly point to either the nerves that go to form a ganglion or plexus, or the nerves distributed from such ganglion or plexus.

3rd.—Certain forces are said to be concentrated in these Chakras, thus identifying them with the plexuses or ganglia which the modern physiologists have proved to be "separate and independent nervous centres."[1]

This Nâdî Suṣumnâ has six Padmas (Shiva Saṃhitâ, Ch. II, v, 27, p. 12), evidently signifying the six nervous plexuses formed by the spinal cord.

The description of the thousand-petalled lotus (Shiva Saṃhitâ, p. 51) shows it to be the medulla oblongata.

We proceed next to the identification of the famous six Chakras of the Tantras:—

i. *Mulâdhâra Chakra* (Shiva Saṃhitâ, p. 44) is the sacral plexus.

ii. *Swadhisthâna Chakra* (Shiva Saṃhitâ, p. 46). There can hardly be two opinions as to its being the prostatic plexus of the modern anatomists.

iii. *Manipur Chakra* (Shiva Saṃhitâ, p. 47) appears to be the epigastric plexus.

iv. *Anahat Chakra* (Shiva Saṃhitâ, p. 47) is the cardiac plexus.

v. *Viṣudha Chakra* (Shiv Saṃhitâ, p. 48) is either the laryngeal or pharyngeal plexus.

vi. *Ajnâ Chakra* (Shiva Saṃhitâ, p. 47) is the cavernous plexus.

We have very briefly hastened over the six Tantric Chakras. We see that these Chakras are the vital and important sympathetic plexuses, and preside over all the functions of organic life.

There can be little doubt that by the "contemplation" on these Chakras, one obtains psychic powers.

"Contemplation" leads to control over the functions of these Chakras or plexuses. "The intimate connection between the sympathetic nerves and the

[1] Gray's Anatomy, 10th Edition.

great viscera renders it highly probable that the sympathetic system has mainly to do with the organic functions. * * * The sympathetic is the system of organic life." When one gets control over the sympathetic nervous system, one is the master of one's body, one can die at will. The heart beats at his will. The lungs, the intestines, nay, all the different viscera of the body, carry on their allotted duties at the command of such a Yogi. Verily, verily, that is the stage of Samâdhi.

The learned translator has treated only of the five externalities of Yoga in his elaborate introduction. He has not dwelt on the Dhyâna, Dhâraṇâ and Samâdhi. As "Pratyahâra is not a distinct method in itself, but is a result of Prâṇâyâma," so Samâdhi is the stage brought about by the processes of Dhyâna and Dhâraṇâ. As "by Pratyahâra, the subjective world overcomes the objective," so by Samâdhi, the spiritual nature of man stands predominant over the gross physical one. Pratyahâra must be clearly distinguished from Samâdhi. No more serious mistakes, we think, can be committed than considering the hybernation of the reptiles and other animals as illustrating the Samâdhi stage of the Yogis. The hybernation corresponds with the Pratyahâra, and not the Samâdhi stage of Yoga. The learned translator has happily compared the Pratyahâra stage with the stage of insensibility produced by the administration of anæstheties, *e.g.*, chloroform (Introduction to the Shiva Saṃhitâ, Ch. X, pp. lvii, *et seq*). But it is a well-known fact that the inhalation of chloroform has little perceptible effect upon the sympathetic nerves. The spiritual conciousness of man is intensified only when the functions of the organic life are brought under his control, and when he can modify and regulate the functions of the different viscera. We repeat that that is the stage of Samâdhi.

It behoves all students of Yoga and occultism then to gain a clear knowledge of these six Chakras, from the contemplation of which he can aspire to attain to the stage of Samâdhi.

Major Basu concludes thus :

"This is an humble attempt on our part to identify these Chakras, and how far we have succeeded in our task, it remains for those who are abler, and more learned than ourselves to decide. It is passing strange indeed, that the three famous Nâdîs of the Tantras, *viz.*, Suṣumnâ, Idâ, and Pingalâ, which, there cannot be the slightest doubt, form the spinal cord, right and left sympathetic cords respectively, have not as yet been identified by any Orientalist. But we believe that as a Tantric work has been rendered into English, greater attention will be bestowed by Oriental scholars in illumining the dark recesses of the Tantric literature, and it is to be expected that within a not very distant date the Chakras, Vâyus, &c., of the Tantras will be more correctly identified."

2. *Osteology.*

The Hindu system of osteology, so far as human anatomy is concerned, which has been thoroughly investigated by Dr. Hœrnle in his learned '*Studies*

in the Medicine[1] *of Ancient India*' can be known from the following works[2] :—

A.— The System of Âtreya-Charaka :—

1. Charaka Saṃhitâ — Sarîrasthâna, VII adhyâya.
2. The Glosses of Chakrapâṇidatta.
3. Bheda Saṃhitâ—Sarîrasthâna, VII adhyâya.
4. The Non-medical version of Yâjnavalkya[3] (III, 84-90). (4th cent. A.D.)
5. The Commentary of Aparârka on „ (India Office MSS.) in 1150 A.D.
6. The Commentary of Vijnâneswara on „ („ „) in 1100 A.D.
7. The Commentary of Sulapâṇi on „ („ „) in the 15th cent
8. The Commentary of Mitramisra on „ („ „) in the 17th cent.
9. The Non-medical version in the Institutes of Viṣṇu[3] (200-400 A.D.)
10. *Vaijayantî*, or the Commentary of Nanda Pandita on Institutes of Viṣṇu, in 1622 A.D.
11. The Non-medical version in the Purâṇas[3]—(i) Agnipurâṇa (369th chapter), and (ii) Viṣṇudharmottarapurâṇa (Part of Garudapurâṇa) which has been quoted by Ballâla Sen in *Dânasâgara* (1100 A.D.)
12. The Non-medical version in the 'Anatomy'—the anonymous work called *Sarîram* (Tubingen University Mss.)

B.—The System of Susruta :—

1. Susruta Saṃhitâ—Sarîrasthânam.
2. Sarîra Padminî (Mss. in the possession of Dr. Cordiar).
3. Commentary on Sarîra Padminî by Vaidyanâtha.
4. Bhâvaprakâsa (Jivânanda's edition of 1875, pp. 40-41).

C.—The System of Vâgbhata I :—

1. Aṣtânga Sangraha (Bombay, Vol. I, p. 244, ll. 3-13.)

D.—Miscellaneous Texts :—

1. Susruta and Vâgbhata on muscles—
   (*a*) Susruta Saṃhitâ—Sarîrasthâna, Ch. V, cl. 33.
   (*b*) Dallana's commentary extracted from Jivânanda's edition, p. 578.
   (*c*) Vâgbhata I, (Bombay) Vol. I, p. 225, ll. 20-21.
2. Susruta on Dissection.
3. Susruta on Homology in Sarîrasthâna, Ch. Vi, cl. 29.
4. Susruta and Vâgbhata on the Eye-ball—
   (*a*) Uttaratantra, Ch, I, verses 166, 17*a*.
   (*b*) Aṣtânga Sangraha—Sarîrasthâna, Ch. V, Vol. I, p. 233, l. 10.
5. Bhoja on *nalaka* or reed-like bones, as reported by Dallana (Jiv., p. 576) and Gayadasa.

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[1] Published by the Clarendon Press, Oxford, 1907.

[2] See pp. 185-242.

[3] "The Law-Book of Yâjnavalkya is the original source of the non-medical version, from which it passed into the Institutes of Viṣṇu and into the two Purâṇas." Hoernle, p. 44.

6. Dallana on the aggregate ten (Jiv., p. 576)
7. Susruta and Vâgbhata on the number of *kurcha.*
8. Susruta and Vâgbhata on the number of ankles.
9. Susruta on the position of cluster and cluster-head.
10. Dallana, Gangâdhara and Nanda Pandita on the collar-bone.
11. Susruta and Vâgbhata on the position of scapula and clavicle.
12. Susruta on the number of scapula and clavicle.
13. Susruta on Amsakuta.
14. " " Amsapitta.
15. Râjanighantu and Amarakoṣa on Bhaga.
16. Susruta and Vâgbhata on Jatru and Grîvâ.
17. Susruta, Vâgbhata and Mâdhava on the Valmika disease.
18. Susruta on Urdhwajatru and Jatrurdhwa.

E.—The System of the Vedas:—

1. The Śatapatha Brâhmaṇa[1] on the Total Number of Bones and Bones in the Head and Trunk (X, 5, 4, 123; XII, 2, 4, 9-14).
2. The Śatapatha Brâhmana on Costal Cartilages (VIII, 6, 2, 7, 10).
3. The Atharva Veda on the Sekleton (X, 2, verses 1-8).

The 'wonderful structure of man' is thus described in the *Atharva Veda*[2] (X, 2):

"1. By whom were brought the two heels of a man? by whom was his flesh put together? by whom his two ankle joints? by whom his cunning fingers? by whom his apertures? by whom his two *uchlakhas* in the midst? who put together his footing (*pratisthâ*)?

"2. From what, now, did they make a man's two-ankle-joints (*gulpha*) below, his two knee-joints above? separating his two back-thighs (*janghâ*), where, forsooth, did they set them in? the two joints of his knees—who indeed understands that?

"3. There is joined, four-fold, with closed ends, above the two knees, the pliant trunk; what the hips are, the thighs,—who indeed produced that, by which the body became very firm?

"4. How many gods (and) which were they, who gathered the breast, the neck-bones of man? how many disposed the two teats? who the two collar-bones? how many gathered the shoulder-bones? how many the ribs?

"5. Who brought together his two arms, saying "he must perform heroism"? what god then set on his two shoulders upon the body?

"6. Who bored out the seven apertures in his head? these ears, the nostrils, the eyes, the mouth? in the might of whose conquest in many places quadrupeds (and) bipeds go their way.

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[1] Hoernle's *Indian Med.*, pp. 105-6.

[2] See the translation and notes in the Harvard Oriental Series, Vol. 8, pp. 567-72. Dr. Hoernle's translation on pp. 110-11 of his work differs slightly from this.

"7. Since in his jaws he put his ample tongue, then attached to it great voice; he rolls greatly on among existences, clothing himself in the waters: who indeed understands that?

"8. Which was that god who (produced) his brain, his forehead, his hind head, who first his skull, who having gathered a gathering in man's jaws, ascended to heaven?[1]"

Its composition is traditionally ascribed to Riṣi Nârâyaṇa, author of the famous hymn on the sacrifice of man (called Puruṣa-sukta), perhaps also a medical man responsible for certain formulæ, *e.g.*, the recipe for the preparation of a medicated oil in Bower MSS. Part III.

3. *Varâhamihira.*

To the above survey of Hindu anatomical literature we should also add the non-medical treatment of the human body in LXVIII chapter of Varâhamihira's *Brihat Samhitâ.* This chapter on the physical features of man called *Puruṣalakṣaṇam*[2] begins thus: "A learned person shall examine a man's (1) Kṣetra (body), (2) Mrijâ (complexion), (3) Swara (voice), (4) Sâra (strength), (5) Saṃhati (joints), (6) Sucha (gloss), (7) Varṇa (colour), (8) Anuka (shape of the face), (9) Unmâna (height), (10) Mana (weight), (11) Prakriti (disposition), (12) Gati (gait) and then predict his fortune." We meet in this chapter with such terms of human anatomy as nails, heels, sinews, ankle, shanks, thighs, knees, loins, abdomen, sides, belly, navel, skin, nipple, bosom, collar-bones, neck, arm-pit, shoulders, arms, fingers, wrists, palm, thumb, fore-finger, chin, lips, tongue, face, ears, cheek, nose, eyes, brows, temples, head.

APPENDIX C.

4. *Dr. Seal on Hindu Physiology and Biology.*

For Seal's notes on Hindu Ideas about Nervous System of Tantras, Vital Force, Heredity, &c., see *Appendices*.

(*b*) *The Scientific Value of Hindu Anatomy.*

By a comparison of the Vedic osteological system with those of Âtreya-Charaka and Susruta, Dr. Hoernle proves:—

(1) The "system of the Atharva-Veda more nearly approaches the system of Âtreya-Charaka than that of Susruta;" and belongs to the "semi-mythical period of the history of Indian medicine." (circa 1000 B.C.)

(2) In the time of Yâjnavalkya, the traditional author of *Satapatha Brâhmaṇa*, who is said to have flourished at the court of Janaka, king of Videha, contemporary of King Ajâtasatru and Buddha, *i.e.*, about 500 B.C., "both the medical schools of Âtreya and Susruta were in existence;" and "he possessed some knowledge of their respective theories on the skeleton.

[1] The remaining verses of the hymn refer to the 'numerous things dear and not dear,' ruin, pleasure, &c., and altogether give a complete picture of social, political and moral aspects of human existence.

[2] Sanskrit Text in the *Bibliotheca Indica* (Calcutta, 1865).

As for Vâgbhata's osteological system, Hœrnle proves that the principle on which his list of bones is constructed is " to take the list of Susruta as its basis and add to it such items of the list of Charaka as do not occur in it," and that it is really a " combination of the two."

The scientific value of Hindu anatomy would, therefore, depend on that of the osteological systems of the two principal schools of medicine. " According to modern anatomy,[1] there are about 200 bones in the adult human skeleton. The early Indian anatomists, on the other hand, count either 360 (Âtreya) or 300 (Susruta) bones. This large excess is principally due to the fact that (besides including the teeth, nails and cartilages) they counted prominent parts of bones, such as are known as ' processes ' or ' protuberances,' as if they were separate bones." As for the difference in the systems of Charaka and Susruta, Dr. Hœrnle remarks :[2] " The statement of Dr. Wise (*Hindu System of Medicine*, p. 52) that the ' difference [between Susruta's total 300 and Charaka's total 360] is owing to their counting the cartilages with the bones ' is hardly correct. Both writers include cartilages in their counts, though in different ways. The difference in their totals is mainly due to Charaka's counting the 32 sockets of the teeth as separate bones, and his including the 20 nails, neither of which are admitted in the count of Susruta."

In the third section of his work, that on the anatomical identifications, Hœrnle's verdict on the Hindu systems of osteology is given. He says : " The views of the early Indian anatomists are surprisingly accurate. This is due to the fact that they were accustomed to the practice of preparing the dead human body for actual examination, and that, therefore, their views were the direct result of an experimental knowledge of the skeleton. It is true that the compendium of Charaka contains no reference whatever to the practice of human dissection ; and it must, therefore, remain doubtful whether, and to what extent, that practice was observed in the school of Âtreya. But there can be no doubt as to the practice being known and observed in the school of Susruta, for his compendium contains a passage[3] which gives detailed instructions regarding the procedure to be adopted in preparing a dead body for anatomical examination."

The following remarks from his Preface may also be quoted : " Probably it will come as a surprise to many, as it did to myself, to discover the amount of anatomical knowledge which is disclosed in the works of the earliest medical writers of India. Its extent and accuracy are surprising, when we allow for their early age—probably the sixth century before Christ—and their peculiar methods of definition. * * * No satisfactory knowledge of human anatomy can be attained without recourse to human dissection. * * * It is worthy of note, however, that in the writings of neither of these two oldest Indian medical writers is there any indication of the practice of animal

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1 Hœrnle, p. 115. The explanation for counting in this manner has also been given.

2 P. 81.

3 The passage occurs at the end of the fifth chapter of *Sarírasthána, vide* Hœrnle, pp. 116-117, 225-226.

dissection. The only mention of an animal subject is in connexion with training in surgery. Thus 'puncturing' is to be practised by the medical pupil 'on the veins of dead animals and on the stalks of water-lily,' similarly, 'extricating,' on the pulps of various kinds of fruits and 'on the teeth of dead animals.'

(*c*) *Propagation of Anatomical Knowledge in Hindu India.*

In ancient and mediæval India the knowledge of anatomy, whether elementary or advanced, was extensively diffused. There are reasons to believe that it was almost universal and not confined only within the circle of students and young men, called Brahmachàris, who received lessons in one or other of the various types of educational institutions. It was scattered broadcast through conventions, traditional usages, canons or rules of art and industry, social and religious practices, Tantric rites, and numerous popular ceremonies among the millions whose vocation in life was no nobler than what in terms of modern socio-ecomomic science may be grouped under (*a*) mechanical or automatic manual work, (*b*) responsible or intelligent manual work or even (*c*) mechanical or automatic brain-work.

The reasons are not far to seek. It is superfluous to remark that it is the numerous schools of Hindu medicine that have preserved and more or less developed the medical knowledge and literature of India through the ages. In every part of the country these have been the direct fountain heads of anatomical research and investigation, and have propagated through their professoriat and alumni, whose number has ever been considerable, the knowledge of the parts of the human (as well as animal?) body among the lay non-medical community at large. The importance attached by ancient Hindu thinkers to anatomical knowledge is to be gathered, however, from the provision they made for its inclusion in the curriculum of studies even for those scholars who would not specialise in Ayurveda. We are thus led to surmise that they wanted to make it an integral part of the liberal education of non-medical Brahmachàris also, and to form an estimate of the pedagogic theory that underlay their educational movements.

There is no doubt that, under the regulations of the Hindu Universities of ancient and mediæval India, a course of anatomy had to be offered by students of law (and social science), Theology as well as of Astronomy (and Astrology). The incorporation of anatomical chapters in some of the traditional text-books on Smrīti Sàstras, Dharma Sutras, Puràṇas, Jyotiṣa, &c., and the commentaries on them by successive schools of scholars who were generally non-medical men, undoubtedly point to the facts—

(1) that even those who would not study Ayurveda did not go without a few lessons in anatomy (something like the 'short-term courses' in modern western Universities),

(2) that even non-medical men had sufficient knowledge of the subject to write commentaries on the medical topics in the treatises on Law, Sociology, Religion, &c,

(3) that the anatomical chapters of non-medical *Sâstras* corresponding to the anatomical primers and handbooks of modern times, had an important position in the literature of Hindusthan; and, as integral parts of social and religious works, which may be looked upon as more or less the *Encyclopædia Indicas*, found a place in every man's library.

We have already noticed in connexion with the survey of Hindu anatomy, what Hœrnle[1] calls the "Non-medical version" of Âtreya-Charaka's System of Osteology. This non-medical version is found (*a*) in two religious text-books, *viz.*, (1) *Viṣṇudharmottarapurâṇa* and (2) *Agnipurâṇa*, and (*b*) in two legal text-books, (1) *Yâjnavalkya Dharma Sâstra* and (2) *Viṣṇu Smriti*. There are certain particulars with regard to the incorporation of anatomical chapters in these works which point to the recognition of their importance to non-medical students by those responsible for it.

In the *Institutes of Viṣṇu* "the passage is in no way required by the context * * incorporated into the text from some other work." Hœrnle believes "the passage was inserted into the *Institutes* by some one who was familiar with the Mitâkṣarâ[2] commentary on the Law-Book." The prose statement in *Viṣṇu* is only a paraphrase and "otiose amplification" of the metrical section in *Yâjnavalkya*. Again, a comparison of the 369th chapter, called *Sarirâvayavah*, or Parts of the Human Body, in the *Agnipurâṇa* with the chapter on Anatomy in the *Viṣṇudharmottarapurâṇa* shows that about two-thirds of its contents are "literally plagiarised from it." "The Law-Book of Yâjnavalkya is the original source of the Non-medical version, from which it passed into the *Institutes of Viṣṇu* and into the two Purâṇas."

Without entering into a discussion of the differences in the anatomical knowledge displayed in these non-medical treatises, it would be sufficient for our purposes to remark that the tendency of incorporating medical chapters with non-medical works.

(1) began as early as at least the 4th century A.D.), when Yâjnavalkya, author of the celebrated Smriti, is supposed to have flourished;

(2) that it has been kept up by latter-day professors of Theology and Sociology, *e.g.*, (i) in the Viṣṇudharmottara (at least as early as 1100 A.D.), (ii) in Viṣṇu Smriti (at any rate before 1622[3] A.D.) and (iii) in the Agnipurâṇa (at the latest 1650 A. D.);[3]

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[1] Pp. 40-46.

[2] "Whoever drew up the list as we find it in the *Institutes*, did so on the basis of Vijnâneswara's interpretation; and accordingly the introduction of that list in the *Institutes* cannot be placed earlier than the date of Vijnâneswara, that is after 1100 A.D. Seeing that the *Institutes of Viṣṇu* appears to be often quoted in the Mitâkṣarâ, it does not seem impossible that the appearance of the list in the *Institutes* is due to Vijnâneswara himself." Hœrnle, pp. 59-60

[3] These dates refer to the introduction or interpolation of the anatomical chapters in the works, not to the general body of the works themselves.

and (3) that it has been preserved by the efforts of successive schools of lay commentators to explain the medical ideas, according to the culture of the ages in which they lived, *e.g.*, (i) Vijnâneswara (Mitâkṣarâ, c. 1100 A.D.), (ii) Aparârka, who though a near contemporary of Vijnâneswara (1150), holds an independent view in the interpretation of Yâjnavalkya, (iii) Sulapâṇi (15th cent.) and (iv) Mitra Misra (17th century), both following the lead of Vijnâneswara.

The same conclusion is arrived at by the fact that a small manuscript, called *Sarira,*[1] or anatomy, has been discovered in the collection preserved in the Tubingen University Library. Its age and author are unknown. Its versified contents are compiled from many different sources, some of which are quoted by name, *e.g.*, Charaka, *Yogamuktâvali*, *Kaulâvali*, &c. Its statement on the Skeleton is taken from the Law-Book of Yâjnavalkya, though the source is not named. But an important error of Yajnavalkya " was detected and corrected by the unknown author of the *Anatomy.*"

The extract from the *Brihat Saṃhitâ* quoted previously also points to the intimate association of anatomy with general Hindu literature and its place in the scheme of education in *Jyotiṣa* (which is not equivalent to what in modern times is called Astronomy, but includes Astrology, Mathematics and many other topics of a social and economic nature). From the very definition of the scope and province of Jyotiṣa and of its three branches—*Horâ*, *Tantra* and *Anga-vinischaya*—as well as the description of the Jyotiṣaka,[2] or the man versed in Saṃhitâ, Astronomy, and Horoscopy, it would be clear that atleast such knowledge of anatomy, physiology, and embryology, as furnishes a working idea of the parts of the body, the nativity, external features of man and animals, is an essential item in the equipment of the students of this science.

From considerations like these relating to the scope of Hindu literature on non-medical subjects we are reasonably led to believe that in ancient and mediæval India no Hindu Brahmachâri was left without the knowledge of a little anatomy; and that the references to limbs or features of human or animal life that we meet with in poetical works, Silpasâstras, Tantras, sacrificial and religious catechisms, or allegorical, moral and didactic treatises are not due to commonplace observations that may be expected of the man in the street, but presuppose, in the absence of evidences to the contrary, the education received by the poets, priests, moralists, story-tellers, scientists and scholars, in their *Brahmacharya Âsram.*

It is this universality of the anatomical instruction imparted by the *gurus* or professors to their pupils which explains the popularisation of knowledge about parts of the body among the community, and its influence on the arts and industries designed to imitate or reproduce human beings or animals. It is this, again, which has left its mark on the Theory and Philosophy of Hindu Art including Architecture, Sculpture and Painting. The 'masters' are very strict in their injunctions that the sculptors and painters should follow with

[1] Hœrnle, pp. 61-622-67.

[2] See the first two chapters of *Brihat Saṃhitâ.*

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religious and mathematical accuracy, the anatomical measurements laid down by them regarding the construction of images of gods and their *vâhanas* or conveyances or symbols.

These canons of Hindu art prove (1) a thorough knowledge of anatomy on the part of the promulgator and (2) their desire to perpetuate and propagate, through more or less durable embodiments, the national ideals of beauty in art as consisting in the closest conformity of artists with the specimens of symmetry and order exhibited by Nature in her great museum of the living universe. Once presented in art, the canons became conventional and have been traditionally followed by sculptors, painters, artists and craftsmen, even by those among them who had not received theoretical or demonstrational lessons in anatomy at schools, from books or from professors. And, besides satisfying the spiritual sense of generations of devoted spectators, both educated and illiterate, these images and works of plastic and other arts have served for them the double purpose of anatomical models as well as object-lessons in æsthetic perfection ;—being at once the national schools of religious, secular and artistic education and culture.

(*d*) *Human Anatomy in Sukranîti.*

The Sukra authors must have had adequate knowledge of human and animal anatomy, as is evident from their care in noting, according to the injunctions of specialists in art-literature, the features of the body in the section on images of gods, and also the external characteristics of animals in the treatment of the economic topics connected with them. The names of the parts of the human body, and their measurements according as the images are to be 7, 8, 9, 10 or 12 *tâlas* (feet) high, will be described in the chapter on the Data of ancient Indian art. Here we shall mention the anatomical features described by Sukrâchâryya in the section on the animal-force of the Hindu state.

(*e*) *External Anatomy of Horses, Elephants, &c.*

It is only the horse that has been fully described in *Sukranîti.* The Sukra authors have given the measurements of the limbs of horses, most probably, as it would appear, to help sculptors in their art. For say they: "If an image[1] is to be made, the appropriate pattern or model should always be placed in front. No image can be made without a model. So the artist should frame the limbs after meditating on the horse, and finding out the measurements and attributes of horses in the manner indicated above." The place of animal-anatomy in Hindu art is quite clear from this extract. But Sukrâchâryya intends these measurements to be remembered also by non-artists, *i.e.*, lay men, whether merchants or rulers or warriors in their sales and purchases of horses.

The general remarks on the quality of horses as known from the proportion between the parts of their body are given in IV, vii, 85-95.

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[1] Sukra IV, vii, 145-47.

We have to remember two things about horse-measurements :—

(1) 5 yavas = 1 angula.

(2) The limbs of horses are to have a fixed proportion to the face.

The quality of horses is indicated thus :—

The best horse has a face of	24	angulas.
Second class „ „	30	„
Third class „ „	32	„
Inferior or ordinary „	28	„

Ordinary horse-measurements are given below :—

Height or stature ...	3 faces.
Length	4⅓ „
Girth	3+3 angulas.

The following are the measurements of the 28 angula-type of Horses :—

(i). Heights. [1]

1.	Heel or hoof (*Śapha*) ...	3 angulas.
2.	Ankle-joint or fetlock (*Maṇivandha*)	4 „
3.	Foreleg or shanks (*Janghá*)	20 „
4.	Knee (*Jânu*) ...	3 „
5.	Fore-thigh or elbow (*Uru*)	14 „
6.	Thigh to neck ...	38 „
7.	Hind thighs (*Uru*) ...	28 „
8.	Hind legs (*Janghá*)	21 „
9.	Neck [2] ...	18 „

(ii) Lengths. [3]

1.	Neck (Grivâ)	80 angulas.
2.	Body (from end of neck to organ) ...	60 „
3.	From organ to end of vertebral column...	18 „
4.	Tail (*Puchchhadaṇḍa*) ...	14 „
5.	Genital organ	14 „
6.	Testicles	14 „
7.	Ear	6, 4 or 5 angulas
8.	Mane or hair of neck [4]	1 cubit.
9.	Hair of tail [5] ...	1½ or 2 cubits.
10.	Eye [6] ...	3 or 4 angulas.

(iii) Circumferences. [7]

1.	Heel or hoof	15 angulas.
2.	Ankle-joint	7½ „
3.	Foreleg or shanks	7½ „
4.	Fore-thigh ...	11 „
5.	Hind thigh	38 „
6.	Hock of the ankle-joint	9 „
7.	Hind leg	7½ „

[1] Sukra IV, vii, 90-101.
[2] Sukra IV, vii, 104.
[3] Sukra IV, vii, 103-108.
[4] [5] [6] Sukra IV, vii, 118-122.
[7] Sukra IV, vii, 109-115.

8.	Forepart of neck [1]	... 32
9.	End of neck [2]	... 46
10.	Forehead [3]	... 36
11.	Face at the nose below the eye [4]	... 19

(iv) Distances, breadth, width or space.

1.	Between two thighs at the back	1 angula.
2.	The neck on which hair grows	1½ "
3.	Ear	... 3 or 4 angulas
4.	Breast	... 19 "
5.	Eye	... 2 or 2½ "
6.	Between two thighs	9 "
7.	" " eyes	5 "
8.	" " ears	5 "
9.	" eye and ear	... 5 "
10.	" two heels ...	...6, 7, &c. "
11.	" two pupils of eyes...	... 9 "
12.	" " eye-brows	... 0 "
13.	" eye and nose	... 9 "
14.	" two nostrils	... 3 "
15.	" arms at breast	... 4 "
16.	Lower lip	... 1½ "
17.	Upper lip ...	... 0 "
18.	Between back and breast	... 1¾ cubits.

About Elephants the following measurements are given in IV, vii, 77-84.
[*N. B.*—8 yavas = 1 angula
24 angulas = 1 cubit.]

	Bhadra.	Mandra.	Mriga.
Height ...	7 cubits.	6 cubits.	5 cubits.
Length ...	8 "	8 "	7 "
Girth ...	10 "	9 "	8 "

About Bulls Sukra authors record the following measurements in IV, vii, 299-302 :—

Girth	= 4 times face.
Height+hump	= 3 "
Length	= 3½ "

The best animal has 7 *tâlas* or feet in height.
The good height of camels is known to be 9 *tâlas* or feet.[5]

(f) Dentition and Age of Animals.

The following table gives the duration of the periods of youth,[6] manhood and old age, as applied to the five principal vertebrates :—

	Maximum age.	Youth.	Middle age.
Man ...	100 years.	20 years.	60 years.
Elephant ...	100 "	20 "	80 "
Horse ...	34 "	5 "	16 "
Bull ...	25 "	5 "	16 "
Camel ...	25 "	5 "	16 "

[1] [2] [3] [4] Sukra IV, vii, 124-128. [5] Sukra IV, vii, 304-5. [6] Sukra IV, vii, 306-313.

The age of both bulls and horses is to be known from the growth and colour of teeth.[1] There is no information about the tusks of elephants.

The whole dental structure of horses is thus described in the *Fauna of British India* :—

" Dentition : Incisors $\frac{6}{6}$, Canines $\frac{1-1}{1-1}$. Premolars $\frac{3-3}{3-3}$, Molars $\frac{3-3}{3-3}$, Canines generally wanting in females. There is sometimes an additional small anterior upper premolar. The incisors have a flat crown, with at first a deep hollow in the middle ; this (the " mark " in horses) disappears with age."

It is evident that Sukrâchâryya, in describing the changes in the development and colour of the six teeth as the guide to the age of horses, is referring to the Incisors or Anterior teeth. This is the practice recognised by the modern science of equine dentistry also. The structural changes in the Back teeth, called Molars or Grinders, afford a very good index of the age of the horse up to the period when they are completed, namely, four years old. But after the fourth year the molars are not often taken into consideration in determining the age of the horse.

Further, these six incisors described in *Sukraniti* do all belong to the lower jaw. Fitzwygram also in his chapter on ' age,' as indicated by teeth, confines his remarks to the incisors of the lower jaw, " as the structural changes which take place in the upper are nearly similar. "

The distinction between Temporary or Milk Incisors and Permanent Incisors, as given by Sukra authors, both as regards the time of development and discolouration, is also borne out by modern science. " The discolouration is due to the lodgement of the juices and other matters connected with the food in the grooves."

The following extract from *Horses and Stables* coroborrates the Sukra theory of Dentition stated in IV, vii, 315-20 : " The foal is born with his teeth in a rudimentary state in the gums. * * * The yearling is complete in all six incisors (315), but several well-marked signs distinguish his mouth from that of the two years old (316). * * * A few months before 3 years old, the horse sheds the two centre milk-teeth which are replaced by permanent. * * * A few months before four, the horse sheds the two next milk-teeth which are replaced by permanent (318). * * * A few months before five the horse sheds the two remaining milk-teeth which are replaced by permanent (319.) Thus the jaw is now furnished with six permanent incisors."

After the dental structure is complete, the guide to the age of horses is colour, as detailed by Sukrâchâryya in IV, vii, 320-324. This is the modern theory also. Says Fitzwygram : " At and after six, we are compelled to have recourse to the indications given by the marks and other slight but gradual alterations which take place in the form of the teeth and their position. * * * The mark is in a constantly changing condition."

[1] Sukra IV, vii, 314.

[2] Pp. 418-19.

The science of equine dentistry has been treated by the authors of *Aswavaidyaka* and *Aswachikitsita* published in the Bibliotheca Indica Series. There is a general agreement between Sukrâchâryya, Jayadatta and Nakula as regards number, colour and development of the teeth as well as their help in the determination of age. Jayadatta deals with the subject in the 4th chapter, and Nakula in the 5th chapter of their works. The traditional order of colour 'black, yellow, white, glass, honey, and conch' is the same in all the three works.

The changes in the colour of horses' teeth according to age, as indicated in Sukra IV, vii, 325-25, are given below :—

1st year	white.
2nd " ...	black and red.
3rd—6th year	black.
6th—9th "	"
9th—12th "	yellow.
12th—15th year	white.
15th—18th "	glass.
18th—21st "	honey.
21st—24th "	conch.

Since 24th year[1] the teeth get loose and separated and begin to fall down every three years. The horse that has attained full age gets three circular rows on the upper lip. The age is to be considered low in proportion as the rows are less.

Regarding the dentition and age of bulls[2] we read :—

(1) All the eight white teeth of bulls grow in their 4th year. The two extreme teeth fall down and are replaced in the 5th ; in the 6th, the next two ; in the 7th, the next two ; and in the 8th, the central two.

(2) Every two years the teeth get black, yellow, white, red and conch-like in order. Then their looseness and fall commence.

Thus each colour lasts for two years. And as all the teeth get finally replaced in eight years, the colour changes up to the 18th. It is evident that Sukrâchâryya means the eight incisors of the lower jaw; as would appear from the dentition of the Bovide described by Murray in the *Vertebrate Zoology of Sind* : "Teeth of two or three kinds. Incisors eight below. Molars six on each side in each jaw. Canines more or less developed. Front of upper jaw toothless."

Sukra authors say nothing particularly about camels. We are simply told that the age of camels has to be understood from considerations like these.[3]

SECTION 17.

Organisation of the Veterinary Department in Sukra Polity.

In the previous sections we have dealt with what the Sukra authors have recorded about the Zoosphere of their country in both its biological and

1 Sukra IV, vii, 325-7.
2 Sukra IV, vii, 332-37.
3 Sukra IV, vii, 338.

economic or utilitarian aspects. We have found that the main references in *Sukraniti* to the live-stock of the land are from the standpoint of the state, especially its military department. The live-stock as belonging to the people have been but casually noticed and have to be inferred from the incidental analogies and illustrations and from the passing remarks in connexion with revenue, agriculture, commerce and industries. It is, therefore, natural that the authors should supply some information about the management and administration of the Veterinary Department in their state.

The Veterinary Department of the Sukra state does not, however, attend to the military live-stock exclusively, though details about this only are available in Sukranîti. It is an organisation addressing itself to the needs of the total live-stock of the state, agricultural cattle, draught-animals, the Fauna in the Zoological Gardens or State Forests, as well as the Animal-Corps, and may be taken to have been divided into two branches, Civil and Military.

The administrative machinery of the Sukra Polity consists of a highly differentiated Bureaucracy divided into special Departments or Bureaus for the management of executive affairs. The Veterinary Department (Civil and Military) is one such Bureau presided over by one of the highest Executive Heads called Ministers or Secretaries, and supervising, guiding and controlling the work of varying grades of officers entrusted with the charge of sectional and sub-sectional affairs. The hierarchy from the menials at the lowest rung of the official ladder to the highest functionary through intermediate grades of officers is complete in the Veterinary as in the many other departments of the Sukra state.

The Sukra Polity recognises 10 *Prakritis*[1] (Executive Councillors, Departmental Heads, Ministers or Secretaries). These are (1) *Purodhâ* (Priest), (2) *Pratinidhi* (Viceroy), (3) *Pradhâna* (Superintendent, Chief Secretary or Prime Minister), (4) *Sachiva* (War Secretary), (5) *Mantri* (Foreign Secretary or Diplomatist), (6) *Pandita* (Learned Adviser or Law Secretary), (7) *Prâḍviveka* (Chief Justice), (8) *Amâtya* (Land Revenue Secretary), (9) *Sumantra* (Finance Minister), (10) *Duta* (Ambassador or Spy), in order of precedence and dignity. Sukrâchâryya states another theory[2] according to which the Prakritis are 8, excluding the priest and the spy. But according to him "the priest[3] is superior to all others—the mainstay of the king and the kingdom," and the spy[4] is a "servant of the rest." The priest and the spy are thus too important to be ignored in the enumeration of the *Prakritis*. So Sukra authors reject the Doctrine of Eight Councillors.

The organisation of the Veterinary Department is typical of all the rest in the symmetrical and scientific scheme devised by the Sukra statesmen. The picture presented in *Sukranîti* is not one of a simple primitive political life in which the man in the street is fit to be a judge, a warrior and a ruler by turns

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1 Sukra II, 141-143.
2 Sukra II, 146-47.
3 Sukra II, 160.
4 Sukra II, 140.

as in the ancient city, states, but one of a complex organisation which requires specialised functionaries for the discharge of its functions, and hence demands of each a specialised training as Judge, Financier, Commander, etc.

The department of the veterinary interests of the state is managed in the following way :—

I.—The King is not a mere "dignified part" of the Sukra constitution. Besides serving the purpose of an ornamental figurehead, he has to discharge several important functions, and is thus an "efficient part"[1] also.

According to the Code of Education for princes the king is bound to be a good sportsman. So far as the Veterinary Department is concerned, "he has to spend one *muhurta* (48 minutes) at dawn in exercises over elephants, horses, &c., spend four *muhurtas* over (among other things) writing orders relating to the army, spend two *muhurtas* in consultation with the Chief Justice and *other ministers*, the same period in hunting, &c., one *muhurta* over military exercises, &c."

The king's contact[2] with the department of live-stock is further advised in the following lines :

"He should every morning and evening exercise himself with elephants, horses, chariots, and other conveyances. And he should learn as well as teach the military arrangements of soldiers. He should sport with tigers, peacocks, birds, and other animals of the forest, and in the course of the hunting should kill the wild ones."

The following rules[3] bring out, again, the very important function of the king in Sukra Polity generally, and in its Veterinary Department in particular : "The ministers are likely to be dumb (*i.e.*, silent) through the passions, cupidity, and fear of the king. The king should receive in written form the opinions of each separately with all his arguments, compare them with his own opinion and then accept the will of the majority. The king should every day examine the elephants, horses, chariots, cattle, servants, officers, provisions and soldiers, and preserve or maintain the able and give up the very old."

II.—The Sachiva (War-Minister) and his Council :

(*a*) The main brunt of the administration of the veterinary interests of the state falls, of course, on the War-Minister, the Sachiva. The constitutional position of ministers or *Prakritis* in the Sukra state and their relations with the king as well as among themselves need not be discussed here. We have to note simply that one of the many items of business that come up before, and have to be administered by, the Portfolio of *Sachiva*, is that

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[1] See the king's daily routine and time-table of work framed by Sukrâchâryya I, 551-570. *Vide* also I, 600, 670-3. The king's important position in the administration of justice has also to be noted. All those topics will be treated at length in Vol. II. (Political).

[2] Sukra I, 603-606. It may be noticed here that Kâmandaka also in his *Niti Sâstra* provides for a regulated exercise with the wild games, &c., in State Forests, though he is very particular against the vice or *vyasana* of hunting.

[3] Sukra I, 730-35.

relating to the Civil and Military sections of the Veterinary Department of the kingdom. Thus we read that "the *Sachiva*[1] has to study the elephants, horses, chariots, foot-soldiers, camels, oxen, bandsmen, &c., * * * and communicate the result of his studies to the king."

(*b*) Like the other Prakritis or Ministers, the War-Minister, also is not to be alone in his jurisdiction. Like the *Pradhâna* and others, the *Sachiva* is to have a council consisting of two members besides himself:

"The king should always appoint three men[2] for each department—the wisest of them all at the head and two others as overseers, for 3, 5, 7 or 10 years, and, having noticed each officer's qualifications for the entrusted work, should make the necessary changes." This War-Council with its President, the *Sachiva*, is thus the real focus of responsibility regarding the Veterinary Department.

III.—The officials of "generalised ability" (and of higher rank):

(*a*) The administrative system of Sukrâchâryya is highly specialised, as we have noticed above. With regard to the Veterinary Department the rule is that the king should appoint separate officers as "the heads or Superintendents[3] of elephants, horses, cattle, camels, deer, birds," &c.

The Civil Service Regulations applicable to all the officials in the State are indicated by the following: (i) "As the officer becomes qualified[4] for the higher and higer functions, he should be appointed to the higher and higher posts. At the end he should be a *Prakriti* (*i.e.*, one of the 10 highest Executive Councillors). (ii) The king should appoint many overseers, superintendents, or only one officer, without any overseer at all, according to the importance of the jurisdiction to be managed.[5]

(*b*) The superintendents in charge of the live-stock[6] may be recruited from, among others, the members of the royal family.

(*c*) The Superintendents or the higher grade office-bearers (something like the Gazetted Officials of modern times) of the Veterinary Department are being described below. These are to have the qualifications for understanding the general interests bearing on the species of live-stock in the charge of each.

(1) *The Superintendent of Elephants*[7] (*âdhoraṇa*): The man who knows of (i) the various species of elephants, *e.g.*, Prâbhadra, Airâvata, Pundarika, &c., (ii) their treatment, diseases and art of rearing them, (iii) the methods of training them, (iv) who can discover and distinguish their qualities by studying the roof the mouth, the tongue, the nails, &c., (v) who knows how to mount them and guide their movements should be appointed to take care of elephants;[8]

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[1] Sukra II, 181-90.
[2] Sukra II, 220-24.
[3] Sukra II, 237-38.
[4] Sukra II, 232-33.
[5] Sukra II, 234-35.
[6] Sukra I, 690.
[7] Sukra II, 256-59.

[8] According to Kautilya this officer called *Hastyadhyakṣa* has two functions: (1) to see that the Elephant-Forests are well-protected (by the officer called *Nâgavanapâla* and his ministerial staff), and (2) to superintend the internal managements in the Elephant stables and the proper training by experts. This second function only has been described by Sukra.

for he is sure to captivate their heart. This officer must have graduated in the whole science of Elephants in both theoretical and practical, as well as biological and economic branches.

(2) *The Superintendent of Horses* (*aswâdhipati*). The man (i) who knows[1] of the feelings of horses, and (ii) can discover and distinguish their qualities by studying their breeds, colour and feathery rings, (iii) who knows how to guide, train and treat them, (iv) and is aware of their mettle, spirit and diseases, (v) who knows what is good and bad nourishment for them, (vi) who knows of their weight, their gait, their capacity for bearing weights, their teeth and their age, (vii) and who, besides, is valorous, an adept in military parades and is wise, should be appointed to the superintendentship of horses. The qualifications for this officer are a thorough mastery in the whole science relating to horses and horse life.

(3) The Superintendents of Bulls and Camels corresponding to those of Horses and Elephants, and Officers of the same grade relating to agricultural cattle, Birds and other species of Live-stock have not been described in Sukranîti, but may be inferred to have been such persons as were well-qualified in the sciences bearing on the Fauna in question.

IV.—Experts, ministerial officers and menials :

The officers and men connected with the actual tending and management of live-stock must be specialists in the narrower range of duties classified according to the principle of the Division of Labour. They need not be well up in the solution of general problems affecting the department or have a wider and more comprehensive outlook than what is absolutely necessary in attending to the 'details' and minuter points of their work. They are what in terms of modern social sciences would be called the men of "specialised skill." As a matter of fact, Sukra knows them to be specialists in the two *kalâs* or arts,[2] *viz.*, of (1) driving and (2) training horses and elephants, &c.

About the appointment of such experts and skilled men, *i.e.*, staff of the lower rank, *viz.*, in the Veterinary Department, we have the following rules :—

(i) Those men are to be masters of goats,[3] sheep, cows, buffaloes, deer, &c., who are skilful in tending and rearing them and who have love for these animals.

(ii) Of like qualifications there should be appointed men to serve elephants, camels[4] &c.

(iii) Other officers are those of a warlike disposition, who know how to domesticate birds,[5] teach parrots, and know when hawks fall victims to arrows as well as the inward feelings of these animals.

[1] Sukra II, 260-63.
[2] Sukra IV, iii. 166.
[3] Sukra II, 297-98.
[4] Sukra II, 299.
[5] Sukra II, 300-302.

(iv) Regarding horses Sukra authors mention three classes of skilled[1] staff :—

(*a*) The *sâdi* or horseman is he who is brave, versed in military parades and battle-arrays and knows of the movements of horses, &c.

(*b*) The *sikṣaka* or trainer of horses is he who (a) knows of the 11 kinds of horses' movements: (1) Circular (2) galloping, (3) prancing, (4) trotting, (5) jumping, (6) speedy, (7) slow or sluggish, (8) tortuous, (9) serpentine, (10) rolling or revolving, (11) galloping at full speed; and (B) can break them according to their strength and the uses to which they would be put.

(*c*) The *sevaka* or groom is he who can serve the horses well, who knows how to place the saddles, &c., and who is able-bodied and brave.

In this organisation of the Veterinary Department we have to notice :—

(1) the fact that it is, as in modern states, administered by the Military Portfolio,

(2) the principle of scientific administration that underlies the whole Bureaucratic organisation of modern politics. This is illustrated, in the case of Sukranîti, as we have just noticed—

(*a*) horizontally, by the introduction of specialisation and differentiation of functionaries through a careful division of functions, and

(*b*) vertically, by the gradual introduction of greater and greater degrees of complexity and generalisation into the work of upper grades from the simple, homogeneous, specialised functions of the lowest man at the bottom, *e.g.*, the groom.

It is not possible from Sukranîti to form an estimate of the expenditure on the Veterinary Department. But the *Arthasâstra* supplies substantial information about salaries, wages, fines, rations, &c.

The following extract from Mr. Law's *Hindu Polity* gives a few more members of the Cavalry-Staff, as well as a few rules that obtained under Chandragupta Maurya pertaining to the Department of Live-stock: "The grooms (*Sutragrâhaka*), those who bound them in stables (*aswavandhaka*), those who supplied meadow grass (*yâvasika*), those who prepared the meals of horses (*vidhapâchaka*), those who watched the stables (*sthânapâlaka*), those who dressed the hair (*kesakâra*), and those who detected poison (*jangulividah*) were liable to a fine of a day's wage for neglect of duty. These *jangulividah* were the grooms, the cooks and the veterinary surgeons, for it was they who had to taste the food of the horses."

The two lists of officers given below are supplied by Kautilya :

(*a*) *Relating to the capture of elephants* :

1. Nâgavanapâla (superintendent of elephant forests), different from the *Hastyadhyakṣa* or *Âdhoraṇa* (Sukra) described above.

[1] Sukra II, 268-75.

2. His assistants:

   i. *Hastipaka* (driver)'

   ii. *Pâdapâsika* (who slips nooses round the legs),

   iii. *Saimika* (boundary guard),

   iv. *Parikarmika* (servants for miscellaneous works),

   v. *Vanacharaka* (foresters),

   vi. *Anikastha* (trainers).

(*b*) Stabling staff:

1. *Chikitsaka* (doctors),
2. *Anikastha* (trainers),
3. *Ârohaka* (drivers),
4. *Âdhoraṇa* (experts who can control the paces of elephants),
5. *Hastipaka* (grooms),
6. *Oupacharika* (attendants),
7. *Vidhapâchaka* (cooks),
8. *Yâvasika* (grass suppliers),
9. *Pâdapâsika*, (who slips nooses round the legs),
10. *Kutirakṣa* (guards),
11. *Upasâyika* (who take care of the animals at night).

APPENDICES

BY

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[It is the privilege of the author to publish along with this work the monographs of Dr. Seal on the mechanical, the physical and the biological theories of the Hindus as well as on the Hindu classification of plants and animals.

It has to be stated with regret that the author could not avail himself of the advantage of discussion with the distinguished savant on the various topics dealt with in the "Positive Background," and that Dr. Seal's papers reached his hands after the work had been in the press.]

APPENDIX A.

HINDU IDEAS ABOUT PLANTS AND PLANT-LIFE.

SECTION 1.

CLASSIFICATION OF PLANTS.

Charaka :—Plants according to Charaka are divisible into (1) *Vanaspatis*, trees bearing fruit without flowers; (2) *Vânaspatyas*, trees bearing flowers as well as fruits; (3) *Auṣadhis*, herbs that wither after fructification; and (4) *Vîrudhs*, other herbs with spreading stems.

Chakrapâṇi :—Chakrapâṇi notes in his commentary on Charaka: the *Vîrudhs* comprise two classes (1) *Latâs*, creepers; (2) *Gulmas*, herbs with succulent (or cactaceous) stems and shrubs. The *auṣadhis* are sub-divided into (1) annuals or perennials, bearing fruit, and (2) plants that wither away after maturing and without fructification, *e.g.*, grasses like the *Durvâ* (Cynodon dactylon).

Susruta and Dalvana :—Susruta's division is identical with Charaka's. Dalvana, the commentator, gives some details. The *plakṣa* (Ficus infectoria) and the *Udumvara* (Ficus glomerata) are given as instances of trees bearing fruits without flowers (*vanaspatis*). It appears that plants with naked and incomplete flowers (Achlamydeous plants) were considered as flowerless, as also trees whose flowers like those of the fig are placed on the internal walls of a common receptacle. Of the *Brikṣas* flower and fruit-bearing trees, the mango tree, the *Jambu* tree (Eugenia jambolana) &c., are given as examples. The *virudhs* are of two classes—(1) creepers with stems spreading on the ground (प्रतानवत्य:) and (2) herbs, with succulent (or cactaceous) stems (गुल्मिन्य: or स्तम्बिन्य: वर्तुलस्तासन्ततिविशिष्टा:). *Auṣadhis* are those that wither away after fructification, *e.g.*, wheat, barley &c., (फलपाकनिष्ठागोधूमादय:) Some divide *auṣadhis* into two classes (1) those that wither after bearing fruit, *e.g.*, paddy, linseed, pulses, &c., and (2) plants that wither after maturity, and bear neither flowers nor fruits, *e.g.*, the mushroom, &c.

Praśastapâda :—Praśastapâda, the Vaiśeṣika Doctor, classifies plants as follows :—(1) *Triṇas*, grasses; (2) *Auṣadhis*, herbs that wither after fructification; (3) *Latâs*, spreading and creeping herbs; (4) *Avatânas*, arboraceous plants and shrubs; (5) *Brikṣas*, trees bearing flowers and fruits; and (6) *Vanaspatis*, trees bearing fruits without flowers.

Srîdhara :—Srîdhara in the *Kandalî* gives *ulapa* as an example of a grass, wheat as an example of *auṣadhi* (annual), the *ketakî* (Pandanus odoratissimus) and the *Vijapura* (Citrus medica) as examples of *avatânas* (Vitapas, arboraceous plants), the *Kovidâra* (Bauhinia) as an example of flower and fruit-bearing tree and the *audumvara* (Ficus glomerata) as an example of a *vanaspati* (flowerless fruit-bearing tree).

Udayana :—Udayana in the *Kiraṇâvalî* notes the *kuṣmânda* (a species of Cucurbita) as an instance of a creeper (*latâ*), and the palms तालादय: as modifications of the grasses *Triṇas*.

Amara, the lexicographer, in the *Vanauṣadhivarga* and the *Vaisyavarga* (enumeration of wild plants and of food-grains) gives some interesting particulars. (1) The trees (the flowering *Brikṣas* and the flowerless *vanaspatis*) are fruit-bearing, and possess woody stems काष्ठसार or trunks (प्रकाण्ड—प्रकाण्ड: स्कन्ध: स्यान्मूलात् शाखावधिस्तरु:). Next come (2) arboraceous plants and shrubs (क्षुप, ह्रस्वशाखाशिफ: क्षुप:) bearing flowers as well as fruits. (3) The *latâs* are next noticed, flowering plants with herbaceous stems, some of them creeping on the ground (प्रतानिनी),

others succulent (गुल्मिनी), others twining or voluble (मूलाद्याग्रं गता लता, वृक्षगामिनी लता—Amara. cf. Mukuta, तरुमूलात् प्रभृति वृक्षाग्रपर्य्यन्तं गता गुडु.च्यादि लतापि अवरोहः—others call this शिफा). Cf. Susruta—लताः प्रतानवत्यः गुल्मिन्यश्च.

(4) Next come the *ausadhis* (in the narrower sense), herbaceous plants, bearing fruit with or without flowers and dying or withering away after fructification. Some instances of *kandasâka* (tubers, rhizomes, corms) are noticed, *e.g.*, the *palându* (the onion पलाण्डुस्तु सुकन्दकः), the *lasuna* (garlic, महाकन्द), &c. But the graminaceae enumerated in the *Vaisyavarga* are the chief instances of the *ausadhis*—plants that die after fructification. These are cultivated *ausadhis*, but their affinities with the next class, the grasses (*Trinas*), are also noted (*e.g.*, धान्यं व्रीहि स्तम्बकरी। स्तम्बो गुच्छस्तृणादीनाम्। तृणधान्यानि नीवाराः। नाडीनालं च काण्डोऽस्य). Last are enumerated (5) the *Trinas*, grasses, of which the characteristic is the formation of *gulmas*, (culms of grasses with annular knots from which leaves spring—स्तम्बो गुल्मे तृणादीनामकाण्डद्रुमगुच्छयोः). It is worthy of note that, in the enumeration of the grasses, the bamboo is considered as a sort of giant grass (तृणध्वज, grass flag, तृणेषु ध्वज इव). The reeds (नलादयः) are also placed among the grasses (नलादयस्तृणं गर्मुच्छ्यामाकमुखमपि। प्रमुखगन्धात् नीवाराद्याः). (6) Finally, the Palmaceae (including the cocoanut, date, areca, and other palms) are classed as Tree grasses, probably because, like the grasses, they are endogens characterised by spikes and parallel veins. तृणद्रुमाः (तृणराजाह्वयस्तालः नारकेलस्तु लाङ्गली etc. एते च हिंताल सहितास्त्रयः खर्जुरः केतकी ताली खर्जुरी च तृणद्रुमाः—cf. also the *Râjanighantu*).

I may add that Amara places (7) parasitical plants among the *latâs*, (वन्दा वृक्षादनी। वृक्षरुहा। जीवन्तिकेत्यपि). They climb trees and feed upon them. These are to be distinguished from climbing plants, like the *guduchi* (Tinospora cordifolia), which have separate roots of their own. They are also to be distinguished from the adventitious roots descending from the branches of trees, like the Ficus religiosa, which are usually termed *avarohás* (अवरोहाः).

The name *śiphâ* is ordinarily applied to the rootlets and suckers by which the tendrils of various creepers are attached to the soil. (शाखा शिफा अवरोहः स्यात्। वटादेः शाखाया: अवलम्बिनी शिफा। मूलाद्याग्रं गता लता। मूलादूर्द्ध्वं गता लता स्यात्—Amara with Bhanuji Dikṣita's commentary. But the Mukuta notes:—तरुमूलात् प्रभृति वृक्षाग्रपर्य्यन्तंगता गुडु.च्यादि लताऽपि अवरोहः। The *guduchi* is also called वत्सादनी, छिन्नरुहा)

The Hindu Materia Medica mentions *Âkâsavalli*, lit. sky-creeper, a name which seems to have been originally intended for some orchids; also *plava* (lit. floating), weeds that float in stagnant ponds, and Śaivâla, mosses and lichens. (*e.g.*, दूर्वाकसेरुप्लवशैवालं जलेन चर्वित पीत शुक्रमेहहरं—*Chakrapâṇi-Samgraha*, also *Bhâva-Prakâsa*). These are not classified, but like the mushrooms must come under the *Pâkanisṭha ausadhis*, Ausadhis that die after maturing, without bringing forth flowers or fruits.

SECTION 2.

ELEMENTARY IDEAS OF PLANT PHYSIOLOGY.

Characteristics of plant life.

The *Nyâya-vindu-tikâ* of Dharmottara, the Buddhist Scholiast, notices the phenomenon of sleep (contraction of leaves in the night) in certain plants (स्वापः रात्रौ पत्रसङ्कोचः)

Udayâna notices in plants the phenomena of life, death, sleep, waking disease, drugging, transmission of specific characters by means of ova, movement towards what is favourable and away from what is unfavourable (वृक्षादयः प्रतिनियतभोक्त्रधिष्ठिताः जीवनमरणस्वप्नजागरणरोगभेषजप्रयोगबीजसजातीयानुबन्धानुकूलोपगमप्रतिकूलापगमादिभ्यः प्रसिद्धशरीरवत्—Udayâna, पृथिवी निरूपणम्). I may add that metaphors drawn from the heliotropic movements of the Suryyamukhi flower are among the stock-in-trade of Sanskrit poetry and belles-lettres.

The Jaina writer, *Guṇaratna*, in his commentary on the *Shaddarśana-Samuchchaya* (circa 1350 A.D.), enumerates the following characteristics of the plant-life: (1) stages of infancy, youth and age, (2) regular growth, (3) various kinds of movements or action, connected with sleep, waking, expansion and contraction in response to touch, also movement towards a support or prop, (4) withering on wound or laceration of organs, (5) assimilation of food according to the nature of the soil, (6) growth or decay by assimilation of suitable or unsuitable food as prescribed in the science of the diseases of plants and their treatment (वृक्षायुर्वेद), (7) disease, (8) recovery from diseases or wounds by the application of drugs, (9) dryness or the opposite, due to the sap which answers to the chyle (रस) in animals, and (10) special food favourable to impregnation. (विशिष्टदौहृदादिभत्वं विशिष्टस्त्रीशरीरवत् यथा स्त्रीशरीरस्य तथाविधदौहृदपूरणात् पुत्रादिप्रसवनं तथा वनस्पतिशरीरस्यापि तत्पूरणात् पुष्पफलादिप्रसवनं) Even the Vanaspatis (flowerless, but fruit-bearing trees) may be made to flower (Cf. Varâhamihira's recipes for the treatment of plants for similar purposes).

(Cf. Guṇaratna, *Tarkarahasyadipikâ*, *Jainamâlâ*, śloka 49).

Sankara Misra in the *Upaskâra* notes as an additional characteristic the growth of organs (or tissues) by natural recuperation after wound or laceration भग्नक्षतसंरोहणं च Upaskâra, Chap. IV, Ahnika 2, Sutra 5 S. B. H. Vol. vi).

Guṇaratna gives a list of plants that exhibit the phenomena of sleep and waking:— शमीप्रपुन्नाटसिद्धेसरकासुन्दकवप्पूलागस्त्यामलकीकतिप्रभृतीनां स्वापविबोधत: —*ibid*). He also notices the sensitiveness to touch of plants like the *Mimosa pudica* लज्जायती लता, which show a manifest reaction in the form of contraction लज्जालूप्रभृतीनांहस्तादिसंसर्गात् यत्र सङ्कोचादिका परिस्फुटी क्रिया उपलभ्यते (*ibid*).

Sexuality.

Very vague ideas were entertained as to the sexual characters of plants. The pollen is called *Rajas*, *puṣpa*, *prasuna*,—names which are also applied to the female menstruum—and Amara expressly states that for females and flowers these elements (and the terms signifying them are the same स्त्रीणां सुमनसां पुष्पं प्रसूनं समम् Amara, *Vanauṣadhivarga*). Charaka (Dridhavala), indeed, distinguishes between the male and the female *vatsa* (or *kutaja*), considering the variety that bears white flowers and large fruits as male (बृहत्फलश्वेतपुष्पः पुमान् Holarrhena antidysenterica), and that which bears red or yellow flowers and small fruits as female श्यावारुणानुपुष्पी स्त्री—असित कुटज Wrightia tinctoria; Charaka, *Kalpasthâna*, (Chap. 5); but this is hopelessly wrong. Even these vague ideas were afterwards completely lost; and the *Râjanighantu* tells us of a grotesque division of plants into male, female and hermaphrodite, based on the slender or stout, the soft or hard, the long or short, the simple or mixed character of the stems and flowers! (*Râjanighantu*, अनूपादि प्रथमो वर्ग: स्त्रीपुंनपुंसकत्वेन त्रैविध्यं स्थावरेष्वपि etc.)

Consciousness.

The Hindu Scriptures teach that plants have a sort of dormant or latent consciousness, and are capable of pleasure and pain (अन्त:संज्ञा भवन्त्येते सुखदु:खसमन्विता:). Chakrapâni notes in the *Bhânumati* that the consciouness of plants is a sort of stupefied (darkened or comatose) consciouness (वृक्षास्तु चेतनावन्तोऽपि तमश्छन्नज्ञानतया शास्त्रोपदेशविषया एव)।

Udayâna also notes that plants have a dormant unmanifested consciousness which is extremely dull अतिमन्दान्त:संज्ञितया, etc.)

The following ślokas from the Mahâbhârata may fitly conclude this section:

वन्यानामपि वृक्षाणामाकाशोऽस्ति न संशय:।
तेषां पुष्पफलव्यक्तिर्नित्यं समुपपद्यते ॥
उष्मतो म्लायते पर्णं त्वक् फलं पुष्पमेव च।
म्लायते, शीर्य्यते चापि स्पर्शस्तेनात्र विद्यते ॥

वाय्वग्न्यशनि-निर्घोषैः फलं पुष्पं विशीर्य्यते ।
श्रोत्रेण गृह्यते शब्दस्तस्माच्छृण्वन्ति पादपाः ॥
वल्ली वेष्टयते वृक्षं सर्व्वतश्चैव गच्छति ।
नह्यदृष्टुश्च मार्गोऽस्ति तस्मात् पश्यन्ति पादपाः ॥
पुण्या पुण्यैस्तथा गन्धैर्धूपैश्च विविधैरपि ।
अरोगाः पुष्पिताः सन्ति तस्माज्जिघ्रन्ति पादपाः ॥
पादैः सलिल-पानाच्च व्याधीनाञ्चापि दर्शनात् ।
व्याधिप्रतिक्रियत्वाच्च विद्यते रसनं द्रुमे ॥
वक्त्रेणोत्पलनालेन यथोर्द्ध्वं जलमाददेत् ।
तथा पवनसंयुक्तः पादैः पिबति पादपः ॥
सुखदुःखयोश्च ग्रहणात् छिन्नस्य च विरोहणात् ।
जीवं पश्यामि वृक्षाणामचैतन्यं न विद्यते ॥ शान्तिपर्व्व, महाभारत ;

APPENDIX B.

HINDU CLASSIFICATION OF ANIMALS.

SECTION 1.

CLASSIFICATION OF ANIMALS.

Charaka.

Charaka mentions four primary divisions :—

(1) *Jarâyuja*, born from the uterus, or rather, placentalia, viviparous (no a-placental mammals were known), *e.g.*, man, the quadrupeds, etc.

(2) *Andaja*, born of an ovum (egg), comprising fishes, reptiles and birds.

(3) *Svedaja* (or *Uṣma ja*) born of moisture and heat, spontaneously or a-sexually generated, *e.g.*, worms, mosquitoes, etc.

(4) *Udvijja*, born of vegetable organisms (भूतानां चतुर्विधा योनिर्भवति जराय्वण्डस्वेदोद्भिदः—Śârîrasthâna, Chapter III) एकैका योनिः अपरिसंख्येयभेदा भवन्ति भूतानामाकृतिविशेषा परिसंख्येयत्वात् *Ibid.*

Prasastapâda.

Prasastapâda begins with two great divisions :—(1) Ayonija, animals that are a-sexually generated, of small dimensions (क्षुद्रजन्तु). (2) Yonija, sexually generated, *i.e.*, from the union of a sperm and a germ element. The latter are sub-divided into (*a*) *Jarâyuja*, lit., placentalia, viviparous (no a-placental mammals were known), and (*b*) *Andaja*, oviparous. Man, the quadrupeds, domesticated and wild, etc., are given as examples of viviparous animals ; and birds, *Sarisripas* (reptiles, etc.) of oviparous animals.

Udayana.

Udayana in the *Kiraṇâvali* notes that *Jarâyu* means the placenta (गर्भवेष्टनचर्म्मपुटकं जरायुः cf. Sridhara in the *Kandali*, जरायुरिति गर्भाशयस्य अभिधानं तेन वेष्टितं जायते इति जरायुजम्). Udayana adds that the term '*Sarisripa*,' includes insects and fishes as well as reptiles, these being all oviparous (सरीसृपाः परितः प्रसर्पणशीलाः सर्पकीटमत्स्यादयः—पृथिवीनिरूपणम्).

Patanjali.

The a-sexually generated animals, as we have seen, are also called *Kṣudrajantus* (lit. small animals). Patanjali in the *Mahâbhâṣya* gives several alternative definitions

(or descriptions) of this class of animals :—They are defined (1) as animals without bones अनस्थिका: क्षुद्रजन्तव: or (2) as animals that do not possess any blood of their own येषां स्वं शोणितं नास्ति ते क्षुद्रजन्तव: or (3) as numbering more than a thousand in a palmful, *i.e.*, minute in size, or (4) as not easily crushed, or (5) as comprehending all animals up to the ichneumon (in the animal series) अथवा नकुलपर्य्यन्ता क्षुद्रजन्तव:—Mahâbhâṣya 2-4-1).

Susruta.

Susruta mentions four great divisions :—(1) *Sansvedaja*, born of moisture and heat. This division is mentioned first, as Dalvana notes, because moisture and heat are essential factors in the generation of all forms of animal life, including the classes that follow, (2) *Jarâyuja*, viviparous or placental, (3) *Andaja*, oviparous, and (4) *Udvijja*, bursting forth (from the ground or perhaps from some previous unmanifest shape, *e.g.*, frogs, coccidæ etc.) The second, third and fourth classes are mentioned in the order of their importance. Subsequently the order of enumeration is changed :—(1) *Jarâyuja*, (2) *Andaja*, (3) *Svedaja*, (4) *Udvijja*. One reading gives the order (1) Svedaja, (2) Andaja, (3) Udvijja and (4) Jarâyuja. Some commentators point out that the order in the text (whatever that may be) is intended to indicate the order of creation by Brahmâ.

Susruta mentions man, *Vyâla* (carnivorous quadrupeds) and *Pasu* (herbivorous quadrupeds) as examples of the viviparous ; birds, snakes and *Sarisripas* as examples of the oviparous ; *Krimis*, *Kitas* and *Pipîlikâs* (worms, insects, ants, etc.) as examples of the moisture-born ; and frogs and the coccidæ (the coccinella) as examples of the animals that 'burst forth' (eruptive or metamorphic ?)

Dalvana.

Dalvana notes that the divisions are really cross-divisions (योनिसंकर) and intended to be such, as the natural divisions of Jiva and species are not all exclusively oviparous or exclusively viviparous. For example, among birds (पक्षिण: winged animals), bats and *Valâkâs* are viviparous (बलाका जतुकादय: जरायुजा:). Indeed *Valâkâs* are some of them oviparous and some viviparous (पक्षिषु बलाका जरायुजा अण्डजाश्च). Among snakes, the *Ahipatâkâs*, a species of non-venomous colubrines snakes, are viviparous (ovo-viviparous ?). Among the moisture-born, there are some kinds of ants (पिपीलिका:) which also lay eggs or burst forth (from the ground or perhaps from some previous unmanifest shape)—(स्वंस्वेदजेष्वपि काश्चित् पिपीलिका अण्डजा उद्भिजाश्च)

The oviparous animals are divided by Susruta into birds, snakes, *sarisripas*, etc. Dalvana notes that the *Sarisripas* include fishes, and *Makaras* (sea-fish with fierce teeth—हिंस्रदंष्ट्रका:), and the 'et cetera' comprehends tortoises and crocodiles (सरीसृपा: शीघ्रगामिन: कृष्णसर्पादयो मीनमकरादयो वा प्रभृति ग्रहणेन कूर्म्मनक्रादीनां ग्रहणम्)! The 'moisture-born' are due to the moisture and heat either of the earth, or of organisms (स्वंस्वेदजा: भुव: शरीरस्य च संस्वेदात् ऊष्मण: जाता:). Of these, the *Krimis* (worms) arise from the moisture of the fæces in the bowels (कृमय: कोष्ठपुरीषादियाष्पसम्भवा:—Dalvana), from putrefying dead bodies (शव Susruta ;—cf. शरीरे क्लिन्ने वेलानन्तर समुत्पन्नानां कृम्यादीनां कथं चैतन्यम्—Guṇaratna, *Tarka-rahasya-dîpikâ*, (*Jainamatam*) ; from decomposing curd or milk (*e.g.*, वर्षासु च स्वेदादिना अनतिदवीयसैव कालेन दध्याद्यवयवा एव चलन्त: पूतनादिकृमिरूपा उपलभ्यन्ते —Jayanta, *Nyâyamanjarî*, *Ahnika* 7, भूतचैतन्यपक्ष).

The second class, *Kitas*, noticed among the moisture-born, include the scorpions, the six-spotted venomous insect *ṣadvindu*, &c., (कीटाश्वृश्चिकषड्बिन्दु प्रभृतय: Dalvana). Of these the scorpions arise from cow-dung, excreta of snakes, rotten wood (क्वच गोमयाद् वृश्चिक: जायते —Pâtanjali, Mahâbhâṣya 1-4-3) cf. also Susruta, *Kalpasthâna*, Chapter 7.

The third class, *Pipilikâs*, ants and the like insects, Dalvana notes, are born of moisture and heat, as well as of eggs, and sometimes burst forth from the ground (भुयसुदुभिद्म जाता उद्भिज्जा—Dalvana). The gnats and mosquitoes (दंशमशकादय:) are also usually placed among the moisture-born. An *anda* (egg) is described as oval, of the form of a *pesi* (muscle ?)—(अण्डं पेश्याकारवत्तुलं—Dalvana. Cf. Sridhara, Kandali, अण्डं विम्बं तेन वेष्टितं जायते, तत् अण्डजं, पृथिवीनिरूपणं)

Chhândogya and Sankara.

It may be noted that the *Chhândogya Upanişada* classifies animals on the basis of their *vija* (ovum or seed), as threefold :—(1) *Andaja*, born of eggs ; (2) *Jivaja*, viviparous ; and (3) *Udvijja*. Sankara explains that the udvijja animals arise from vegetable organisms (उद्भित् स्थावरं ततो जातम् उद्भिज्जम्) which is also Charaka's view, as we have seen. But unlike Charaka, Sankara holds that the *svedaja* animals must be included partly under the oviparous, and partly under the *udvijja* (vegetable-born) class (अण्डजोद्भिज्जयोरेव यथासम्भवमन्तर्भाव:)—Chhândogya, Prapâthaka 6, Part 3).

Evidently the idea is that, though vegetable organisms may pass off into animal, there cannot be generation without *vija* (seed or ovum), and inorganic matter without *vija* (seed or ovum) cannot give rise to animal life. Pâtanjali, in the *Mahâbhâşya* (circa 150 B.C.) mentions the opposed view, which holds that not only animal organisms but also vegetable organisms, *e.g.*, grasses, grow from inorganic matter. The Durvâ grass, for example, can grow from deposits of the hair of goats and cows, just as scorpions are seen to develop out of cow-dung. Pâtanjali notes the orthodox Sânkhya-Vedânta explanation that these are not cases of growth (or transformation) but merely of coming out (अपक्रामन्ति) कथं गोमयाद् वृश्चिको जायते गोलोमाविलोमेभ्य: दूर्वा जायन्ते, इति अपक्रामन्ति ता वस्तुभ्य: —Mahâbhâşya, 1-4-3.

The Dietary Animals in Charaka and Susruta.

In noticing different kinds of meat for dietary purposes, Charaka gives a classification of animals (mammals and birds) which has only a practical (therapeutic) significance.

The dietic value of the flesh of any animal was conceived to depend mainly on its habitat and mode of life. Dietary animals (mammals and birds) were accordingly divided into eight classes (अष्टविधा योनिस्तेषाम्)

(1) *Prasaha*, carnivorous as well as non-carnivorous (Chakrapâņî), comprehending land-quadrupeds and birds that fall on their food with force,

(2) *Anupa*, animals that live in marshy or water-logged lands or graze on river banks,

(3) *Bhusaya* or *Vilesaya*, animals that live in underground holes,

(4) *Vârisaya*, aquatic animals, both fresh-water and oceanic,

(5) *Jalachara*, amphibious animals,

(6) *Jângala*, animals that live in dry and elevated (hilly) jungle lands, mostly species of deer,

(7) *Vişkira*, birds that scatter their food in picking up, and

(8) *Pratuda*, birds that pierce or torment their food (worms and fruits) with the beak.

In the chapter on articles of diet, Susruta gives a practical classification of (vertebrate) animals for dietary purposes. Animals that find a place in this dietary are first divided into two classes :—(I) *Anupa*, animals that live in marshy or water-logged land (or in water) ; (II) *Jângala*, animals that live in dry (hilly) jungle land. The Jângalas are divided into five classes, and the Anupas into eight. The thirteen classes are based on real and natural distinctions of food and habitat ; they are for dietary purposes arranged

under six conventional (or artificial classes) (त्रयोदश भेदा षट्सु एव अन्तर्भूत । संख्येयम् । निर्दिष्टादेव षट्संख्यायां लब्धायां षड्ग्रहणम् तेन षड्वर्गा इति नियमार्थम्—Dalvana, Sutrasthâna Chapter 27). These thirteen classes of dietary animals may be enumerated as follows :—

I. *Jángala* animals—*Janghála*, *Viṣkira*, *Pratuda*, *Guhâsaya*, *Prasaha*, *Parṇamriga*, *Vilesaya* and *Grámya*, and

II. *Anupa* animals—*Kulechara*, *Plava*, *Kośastha*, *Pâdina* and *Matsya*.

Of these, the *matsyas* (fishes) are divided into two groups, freshwater (lit. river-water) and sea-water fishes. Among the sea-fishes, the Timi and the Timingala (cod-fish or whales ? तिमिमहत्तमो मत्स्य: तिमिङ्गिलस्ततोऽपि महत्तम:—Dalvana) find a place, as also the *makara*, (shark—हिंस्रदंष्ट्राक:—Dalvana).

The *kosastha* (living in shells-mollusca) are distinguished from the *matsyas* (fishes). In this class are enumerated *sankhas* (conchifera), *sankhana* (smaller conchifera), *sukti* (pearl mussels), *sambuka* (Helix) with spinal shell (आवर्त्तकोश:—Dalvana,) *valluka* (a species of Helix, according to some (सन्ने सम्बुक भेदभापु: Dalvana), etc. Dalvana adds *vodika*, *jalasukti*, and various species of Helix (वोडिकजलशुक्तिशम्बूकभेदा बहुविधा गृह्यन्ते)

The *pâdinas*, aquatic animals having pedal (or long dorsal) appendages, comprise the *kurmas* (oval or oblong-shaped tortoises, turtles), the *kumbhiras* (crocodiles, emydosauria, reptilia), the *karkatas* (white and black crabs, crustacea), the *sisumara* (a species of the Delphinidæ cetacea) muscular, with a sharp protruding snout, breathing with the blow-hole *out of the water*, probably a dolphin, as the long dorsal fin was taken for a sort of pedal appendage (दंष्ट्राकारोद्ध्वं पक्ष: बहिर्निश्वासं मुञ्चति सोऽपि द्विविध: वर्त्तुलदीर्घभेदेन —Dalvana). The *pâdinas* do not represent any natural division.

Of the other *Anupa* animals (aquatic or amphibious animals), the *plavas* (lit., floating on the water) represent a class of birds (the Natatores and the Grallatores) exemplified by geese, ducks, cranes, &c.

The *Kulecharas* are herbivorous quadrupeds that frequent the banks of rivers and ponds, and comprise the elephant, the rhinoceros, the *Gávaya* (*Bos gavæus*), the buffalo, various species of deer, &c.

Of the land-animals (*Jángala*), three of the sub-divisions represent birds, and five, mammals. The Land-Birds are (1) the *Prasaha* birds, birds of prey proper (Raptores), comprising the vultures, kites, hawks, owls, &c. (Charaka's *Prasaha* is a much wider class) (2) the *Vishkiras*, birds that scatter their food in picking up, and (3) the *Pratudas*, birds that pierce or torment their food (fruits or worms) with the beak. The last two classes comprehend between them the *Passeres* (proper and so-called), the *Scansores*, the *Rasores* and the *columbæ*.

The remaining five classes of *Jângala* animals are mammals, with the exception of several species of *Vilesayas*, which are reptiles. The *Parṇamrigas* (arboreal animals) comprise the apes, sloths, squirrels, as also some of the reptiles and carnivora. Among the *Parṇamrigas*, the *Putighasa* is a kind of tree-cat giving out a pungent odour ; the *madgumuṣika* and the *Brikṣaśâyika*, are arboreal rodents ; and the *Avakusha*, is a species of cow-tailed monkey (*vide* Dalvana). The *Janghálas* are wild animals, herbivorous quadrupeds that are strong-legged and quick-footed, comprising various species of deer and antelopes.

The *Grámyas* (lit., living in or about villages, domesticated quadrupeds) comprise the horse, the mule, the ass, the camel, the goat, the sheep, &c. They are non-carnivorous, being distinguished from the carnivorous quadrupeds (क्रव्याद्—Susruta, मांसाद् Charaka). Some are *Ekasapha* (animals whose hoofs are not cloven) (ग्राम्यशब्देन च एकशफशब्देन च ग्राम्या:—अश्व: खुर:—Dalvana).

The *Guhâsayas* are carnivorous quadrupeds (क्रव्यादः) living in natural caves or hollows. They comprise the lion, the tiger, the wolf, the hyena, the bear, the panther, the cat, the jackal, the *mrigevaru*, &c. The *vrika* (wolf) is defined as a dog-like animal, small-sized (in comparison with the lion and the tiger). By the cat, here, wild cats are meant. The *mrigevaru* is described as a jackal-like animal that kills deer.

Finally come the *Vilesayas*, animals that live in holes or burrow, comprising various species of Rodents and Insectivora, and several species of Reptiles.

Snakes in Nâgârjuna.

The Snakes (ophidæ) are especially noticed by Susruta. (Nâgârjuna in the chapters relating to Toxicology, *Kalpasthâna*, Chapter 4). Five different genera or families are noticed, of which one is non-venomous, and four venomous, including one hybrid and three pure or unmixed families. Of the last, (1) the *Darvikaras* (कृष्णसर्प महाकृष्ण, पद्म, महापद्म, शङ्खपाली.-- Tripudians, Naia Bungarus, Colubridæ) are hooded, swift in their movements, diurnal in their habits, and bear on their hoods or their bodies the marks of chariot wheels, ploughs, umbrellas, rhombs or cross-bands, goads, &c. (2) The *mandali* (Vipera and Trimeresums, Viperidæ ?) are thick (पृथवः), slow-moving, nocturnal in their habits, and bear circles or rings on the body (आदर्शमण्डल). Charaka adds that they are without hoods. (3) *Ragimats* also are without hoods and nocturnal, and bear series of dots or marks, and are often of variegated colours on the upper parts and sides (Colubridæ, Bungarus Callophis, Dryophis, &c., ?). Twenty-six varieties are named of the first, two of the second, and ten of the third.

Of the *Nirvisas*, non-venomous snakes, twelve varieties are mentioned, including Boidæ अजगर and the columbrine Dendrophis, (वृक्षेशय.) Of the *Vaikaranya* (hybrid) snakes, there are ten varieties, of which three are produced by the union of certain venomous species, and seven are secondary derivative forms.

The *Danikaras* are most deadly when young, the *Mandalis* when middle-aged, the *Ragimats*, when aged. Their poisons act differently, and an elaborate description is given of the action of the venom of each of the three venomous families.

Snakes in the Purâṇas.

The *Bhavisya Purâṇa* gives the following additional information. The *Nâgas* (Naiæ, Colubridæ, Snakes) copulate in the month of *Jyaistha* or Âṣâḍha (May or June), gestate during the rainy months that follow, and bring forth about two hundred and forty eggs in the month of *Kârtika* (November). Most of these are devoured by the parents, but those that are left break forth from the shell in about two months (or one month, according to the *Agnipurâṇa*).

Eggs of a golden hue like that of the (red) flowers of the *Calotropis gigantea* (सुवर्णार्कवर्णनिभ) produce male young ones, those somewhat paler and of an elongated ovoid shape (अर्कोदकसुवर्णाभात् दीर्घराजीवसन्निभात्) bring forth female snakes, and those of the hue of the *Sirisa* blossom hermaphrodite ones. By the seventh day the young snakes turn dark; in a fortnight (or twenty days, according to another account) the teeth come out. The poison is formed in the fangs (दंष्ट्रासु) in three weeks, and becomes deadly in the twenty-fifth night. In six months, *Nâgas* shed the skin (कञ्चुक).

In moving on the ground, the folds of the skin on the under-surface alternately expand and contract, appearing to put out and draw in fine filament-like legs, about 240 in number. The joints on the skin (scabs or scutes—सन्धयः) are two hundred and forty in number (perhaps the sub-caudals were not counted).

Snakes are killed by men, mungooses, peacocks, *Chakoras* (a kind of partridge), scorpions, boars, cats, and the hoofs of oxen. Escaping death from these enemies, a

Nága may live for a hundred and twenty years. The term of life of the non-venomous snake is shorter, about seventy-five years. (*Bhavisya Purána* पञ्चमोक्तम्).

The *Agnipuráṇa* gives the total number of teeth (of a Nága) as thirty-two; of which four (two on either side) are venomous; *viz.*, *Kálarátri* and *Yamadutiki*, which appear to be the names of the fangs, and *Karáli* and *Makari* which seem to stand for two hard (maxillary) teeth accompanying the two fangs (cf. also Charaka—Dridhavala, *Chikitsá-sthána*, XXIII, विषचि किरितम्).

Umásvati's Classification of Animals.

A more thorough classification of animals is found in the ancient Jaina work, the *Tattwárthádhigama* of Umâsvati, which the Jaina chronological lists enable us to assign with great probability to the fourth or fifth decennium after Christ (circa 40 A.D). Umâsvati's classification is a good instance of classification by series, the number of senses possessed by the animal being taken to determine its place in the series. Perhaps only senses actively determining the life-habits were counted.

I. First come animals with two senses, *viz.*, touch (as evidenced by contractility of tissue) and taste (as involved in the selection and rejection of food). This division comprises—

(*a*) *Apádika* (Vermes without lateral appendages, Scolecids).

(*b*) *Nupuraka* (Ring-like, with pendants, vermes with unsegmented lateral appendages, Annelids).

(*c*) *Gandupáda* (Knotty-legged, Arthropoda, including Crustacea, Myriapoda, &c).

(*d*) Some forms of Mollusca, *e.g.*, *Sankha* (Conchifera, Lamellia branchiata), *Suktika* (Pearl-mussel, Lamellia branchiata), and *Sambuka* (Helix).

(*e*) *Jaluká*, Leeches (Annelids).

II. Next come the animals with three senses, namely, smell in addition to the primordial senses of touch and taste involved in the contraction of tissues and the appropriation of food. Here also well-developed and active senses alone were perhaps intended. Rudimentary or dormant senses were not reckoned. This division comprises—

(*a*) *Pipiliká* (Ants, Formicidæ, Hymenoptera).

(*b*) *Rohiniká*, red ants (Formicidæ, Hymenoptera).

(*c*) *Upachiká, Kunthu, Tuburaka*, bugs and fleas (Hemiptera, Hemimetabola).

(*d*) *Trapusavija* and *Karpásasthika*, cucumber and cotton weasels and lice (Aptera, Ametabola).

(*e*) *Satapadi* and *Utpalaka*, Spring-tails (Aptera, Ametabola).

(*f*) *Triṇapatra*, Plant lice.

(*g*) *Kástha-háraka*, Termites, white ants (Neuroptera, Hemi-metabola).

III.—Then come the animals with four well-developed and active senses, *i.e.*, sight, smell, taste and touch.

This division comprises—

(*a*) *Bhramara, Varata*, and *Sáranga*—Bees, Wasps and Hornets (Hymenoptera, Holometabola).

(*b*) Maksiká, Puttiká, Dauśa and Maśaka—Flies, Gnats, Gadflies and Mosquitoes (Diptera, Holometabola).

(*c*) Vrischika and Nandyavarta—Scorpions and Spiders (Arachnida, Arthropoda).

(*d*) Kita—Butterflies and Moths (Lepidoptera, Holometabola), and

(*e*) Patanga—Grasshoppers and Locusts (Orthoptera, Hemimetabola.)

IV.—Finally come the animals (man and the Tiryyak-yonis) with five well-developed and active senses. Omitting man, this division comprises—

(*a*) Matsya, fishes,
(*b*) Uraga,
(*c*) Bhujanga,
(*d*) Pakṣi, birds, and
(*e*) Chatuṣpada, quadrupeds.

Uraga and Bhujanga in popular use mean reptiles ; but here evidently Bhujanga is taken to mean oviparous limbed animals (limbed reptiles and batrachians) and not creatures whose movements are crooked or in the form of a bent bow; and Uraga stands for apodal reptiles including snakes (ophidiæ).

It will be seen that the first three divisions fall under the Invertebrata, and the fourth is identical with the Vertebrata.

This last division (the Vertebrata) is sub-divided on a different basis, *viz.*, the mode of reproduction. The sub-divisions are three :—

A.—*Andaja*, oviparous (Pisces, Reptilia and Batrachia), *e.g.*, *Sarpa* (Snakes, Ophidia, Reptilia), *Godha* (Varanidæ, Lizards, Reptilia), *Krikalāsa* (Chameleons, Reptilia), *Grihagolika* (Common Lizards—Lacertilia), Matsya (Pisces) *Kurma* (Tortoises—Chelonia, Reptilia), *Nakra* (Crocodiles, Reptilia), *Sisumāra* (Dolphin or Porpoise, Cetacea) and Birds proper with feather wings—the *Lomapakṣa pakṣis*.

Porpoises are erroneously put here being really viviparous like other cetacea. Frogs are not mentioned in this list. The omission is strange. Perhaps (as in Susruta) frogs were believed to be *Udvijja* (eruptive or metamorphic) and not *Andaja* (oviparous). But Susruta mentions the frogs after the quadrupedal and centipedal Reptilia (*Kanava, Godheraka, Galagolika* and *Satapadi*).

B.—*Jarāyuja*, mammals born with placenta, including all mammals other than the *Potaja*. (Here *Jarāyuja* is used in a restricted sense) :—(1) Man, (2) Cow, (3) Buffalo, (4) Goat and Sheep, (5) Horse, (6) Ass, (7) Camel, (8) Deer, (9) Yak (*Chamara*), (10) Hog, (11) Bos Gavæus (Gâveya)—Ungulata, (12) Lion, (13) Tiger, (14) Bear, (15) Panther, (16) Dog, (17) Jackal, (18) Cat (Carnivora), etc.

The apes, though not expressly mentioned, are also to be included.

C.—*Potaja*, a class of placental mammals comprising the Deciduata with the exception of Man, the Apes and the Carnivora : —*e.g.* *Sallaka* (Porcupine, Rodentia), *Hasti* (Elephant, Proboscidea), *Svavit* and *Lāpaka* (Hodgehogs and other creatures that lap up, Insectivora), *Sasa* and *Sayika* (Hare, Rabbits and Squirrel, Rodentia), *Nakula* (Ichneumon, which though carnivorous is supposed to come under the Deciduata), *Muṣik* (Mice, Rodentia) and the *Charma pakṣa Pakṣis*, so-called birds with leathern wings (Bats, Chiroptera), *e. g.*, *Valguli* (Flying Fox), *Pakṣivirāla* (Flying Cat, Micro-Chiroptera) and *Jalukā* (apparently meaning blood-sucking Bats or Vampires, though these are scarcely found in the old world).

The *Potaja* class thus comprises the following Deciduata :—Proboscidea, Rodentia, Insectivora and Chiroptera.

The term *Potaja* is intended to signify that these animals are born without the placenta which is thrown off as an after-birth, whereas such of the *Jarāyujas* as are not *Potajas* are born with the placenta attached to the embryo. But it is not easy to explain why man, the Apes and the Carnivora should not also be reckoned among the *Potajas*.

कृम्यादीनां पिपीलिकादीनां भ्रमरादीनां मनुष्यादीनां च यथासंख्यमेकैकवृद्धानि इन्द्रियाणि

भवन्ति । यथाक्रमम् । तद् यथा कृम्यादीनां अपादिक-नूपुरक-गण्डूपद-शङ्ख-शुक्तिक-शम्बूक-जलूका-प्रभृतीनां स्पर्शनरसनेन्द्रिये भवतः । पिपीलिका रोहिणिका-उपचिका-कुन्थुतुबुरक-त्रपुसबीज-कर्पासास्थिका-शतपद्युत्पतक-तृणपत्र-काष्ठहारक-प्रभृतीनां त्रीणि स्पर्शनरसनघ्राणानि । भ्रमर-वरट-सारङ्ग-मक्षिकापुत्तिका-दंश-मशक-वृश्चिक-नन्द्यावर्त्त-कीट-पतङ्गादीनां चत्वारि स्पर्शनरसनघ्राण चक्षूंषि । शेषानां च तिर्य्यग्-योनिजानां मत्स्योरगभुजङ्गपक्षि-चतुष्पदानां सर्वेषां च नारकमनुष्यदेवानां पञ्चेन्द्रियाणि । (Umāsvati, Tattvarthādhigaṇa, Chap. II, Sutra 24).

जरायुजानां मनुष्य-गो-महिषाजाविकाश्व-खरोष्ट्र-मृग-चमर-वराह-गवय-सिंह-व्याघ्रर्क्ष-द्वीपि-श्व-श्रृगाल-मार्जारादीनाम् । अण्डजानां सर्प-गोधा-कृकलास-गृहगोलिका-मत्स्य-कूर्म्म-नक्र-शिशुमारादीनाम् । पक्षिणां च लोमपक्षाणां-हंस-चाष-शुक-गृध्र-श्येन-पारावत-काक-मयूर-मद्गु-बक-बलाकादीनाम् । पोतजानां शल्लक-हस्ति-श्वाविल्लायक-शश-शायिका-नकुल-मूषिकादीनाम् चर्मपक्षिणां च पक्षाणां जलूका-वल्गुलि-भारण्ड-पक्षिविरालादीनां गर्भोजन्म। (Umāsvati, *ibid*, Chap. II, Sutra 34).

SECTION 2.

RE-CAPITULATION.

The ancient Hindu classification of animals, as gathered from the authorities mentioned above, may be briefly summarised thus :--

A.—*Kṣudrajantus*, boneless and without (red) blood. Invertebrata, divided into

(a) *Ayonija*, a-sexually generated, *e.g.*, the *Svedaja*, born of moisture and heat, and the *Udvijja* (vegetable-born, *e.g.*, the coccinella) and

(b) *Yonija*, sexually generated, *e.g.*, the *Andaja*, oviparous.

But some are both a-sexually and sexually generated, being both *Svedajas* and *Andajas*, or *Udvijjas* and *Andajas*.

The *Kṣudrajantus* (Invertebrata) comprise—

(I) the *Krimis* vermes : (a) *Apādikas* without lateral appendages (cf. Scolecids), (b) *Nupurakas*, Annelids (a section), (c) *Gandupadas*, Arthropoda (a section).

(II) the *Jalukâs*, Leeches, of which twelve species are described, six venomous, and six innocuous (cf. Susruta's careful description, *Sutrasthâna*, Chap. 13),

(III) *Kosqsthas*, shelled animals, some forms of mollusca, *e.g.*, the *Sankhas* (Conchifera), the *Suktikas* (Pearl-mussels), the *Sambukas* (spiral-shelled, Helix), the *Vodikas*, etc.,

(IV) then the Insects typified by the Ants comprising

- (a) *Pipilikâ*, *Rohiṇikâ* (Ants, Hymenoptera).
- (b) *Upachikâ*, *Kunthu*, *Tuburaka* (bugs and flies, Hemiptera).
- (c) Cucumber and cotton lice (Aptera).
- (d) *Satapadi*, *Utpataka* (Spring-tails, Aptera).
- (e) *Triṇapatra*, grass or plant lice (Aptera).
- (f) *Termites* (Neuroptera).

(V) Insects typified by the Hexopoda comprising—

- (a) *Bhramara*, *Varata*, *Sâranga*, Bees, wasps and hornets,
- (b) *Makṣikâ*, *Puttikâ*, *Dansa*, *Masaka*, Flies, gnats, gadflies, and mosquitoes,
- (c) *Vrischika* and *Nandyâvarta*, Scorpions and spiders (Arachnida, Arthropoda),
- (d) *Kita*, Butterflies and moths, and
- (e) *Patanga*, Grasshoppers and locusts.

Susruta-Nâgârjuna names six varieties of ants, six varieties of flies, five of mosquitoes, (including one marine and one mountain kind), eight varieties of *Satapadis* (centipedes), thirty varieties of scorpions and sixteen of spiders (Lutâs). Of the *Kitas*, the glow-worm and the *Tailakita* (lit., oil-worm) are said to be luminous (phosphorescent, (cf. *Râjanighantu* खद्योततैलकीटौ).

B.—The *Tiryyakyoni* animals, sexually generated animals other than such of the ovipara as are included under the *Ksudrajantu*, in other words, sexually generated animals possessing bones and blood—corresponding to the vertebrata—comprise the following classes :—

I. *Andaja*, oviparous :—

(a) The *Matsyas*, fishes, divided into river-water fishes and sea-fishes. Susruta names eleven species of the latter. The '*Timi*' (cod-fish, whale) is reckoned as a sea-fish. The *Makara* (shark) is also mentioned, but the *Kurmas*, *Kumbhiras* and *Sisumâras* (tortoises, crocodiles, and dolphins) are excluded from the class, as also the so-called shell-fish, being placed among the *Pâdinas* and the *Kosasthas* respectively.

(b) The *Uragas*, apodal reptiles :—including the Sarpas (snakes, ophidia). Five classes of snakes are mentioned, one non-venomous, three venomous, and one hybrid. Eighty varieties of snakes are named, but the classification is based on superficial characters, *e.g.*, markings on the scales, etc., and do not touch any anatomical peculiarities. The pathological observations regarding the distinct action of the poisons of different orders seem to be good.

(c) *Bhujangas*, oviparous animals with lateral, pedal appendages, both Reptiles and Batrachians. Many of these are quadrupedal and five-clawed. चतुष्पादाः कीटाः पञ्चनखाः (Dalvana.)

Illustrations.

1. *Godha*, *Grihagolika* and *Krikalasa* (Varantas lizards, common lizards and chameleons). Susruta names four varieties of the *Kanava*, a species of chameleon-like lizards—(cf. Ladyayana quoted by Dalvana, *Kalpasthâna*, Chapter 8), also six varieties of *Galagolika* (a species of lizards), and five varieties of *Godheraka*, Varanus-like lizards, but smaller in size.

2. *Kurmas* and *Nakras*, tortoises and Crocodiles (Chelonia and Emydosauria, Reptilia). Some species of the former are oval, others elongated (वृत्तं स्दीर्घादिर्भेदाः)

3. *Sisumâras*, the Delphinidæ (Odontocete cetacea).

Susruta mentions the frogs (*Udvijja*, eruptive or metamorphic ?) after the quadrupedal and centipedal Reptilia (*Kanava*, *Godheraka*, *Galagolika* and *Satapadi*). Eight species of frogs are named. The frogs are explained by the mythologist to have arisen from dirty water in the rainy season, ... प्रावृट्काले ततः (*i.e.* महेश्वरगुरुत्वात्) मण्डोदके जाता -- cf. Dalvana, *Kalpasthâna*, Chapter 8.

Susruta's *Pâdinas* (aquatic animals having pedal or long dorsal appendages) are a conventional class formed for practical dietary purposes, and include (2) and (3) and also the Karkatas, crabs, (crustacea). *Umâsvati's* Bhujanga class, being a natural sub-division of vertebrates, does not include crustacea which are rightly placed among the invertebrates.

(d) *Lomapakṣa pakṣi*, winged animals with feathery wings, Birds proper. These are oviparous, while the winged animals with leather wings (चर्म्मपक्षपक्षिणः) are placentalia of the Deciduata class (पोतजाः)

The Birds proper are divided into four classes :—

(1) *Plavas*, aquatic or amphibious birds, comprising the Natatores and the Grallatores. Various species are described.

(2) *Viṣkiras*, those that scatter their food in picking up.

(3) *Pratudas*, those that pierce or torment their food (fruits or grains).
The enumeration of the species under (2) and (3) shows that these two classes included the Passeres (vere and so-called), the Scansores, the Rasores and the Columbae.

(4) *Prasahas*, birds of prey proper (Raptores).

Dalvana's descriptions of deer and birds are precise, turning upon coloration, habits of life etc., *e.g.*, the descriptions of the Ruru, the Kârandava, and the Kanka, expressly quoted from some (unnamed) Hand-books :—

कूलचरमाह...रुरुः शरदि शृङ्गत्यागी । तल्लक्षणं उच्यते—

"विकटबहुविषाणः शाम्बराकारदेहः सलिलतटचरित्वात् सञ्चरेभ्यः विचित्रः । त्यजति शरदि शृङ्गं रौति"—इत्यसौ रुरुः स्यात् ।

कारण्डवः शुक्लहंसभेदोऽल्पः अन्ये करहरमाहुः । उक्तञ्च कारण्डवः "काकवक्त्रो दीर्घाङ्घ्रिः कृष्णवर्णभाक्" इति ।

प्रसहानाह...कङ्कः दीर्घचञ्चुर्महाप्राणः । उक्तं च "कङ्कःस्यात् कङ्कः मल्लाख्यो वाणपत्रार्हपक्षकः । लोहपृष्ठो दीर्घपादः पक्षाधः पाण्डुवर्णभाक् ।" इति ।

The sources from which Dalvana derives detailed information about these varied forms of animal life are now unavailable, but these extracts abundantly testify to the minute nature study of the Hindus.

The Hindus had of course no idea of an anatomical classification of birds.

The ancient writer, Lâdyâyana, had a much better idea of zoological description in reference to the *Kitas* (insects and reptiles, *vide infra*).

II.—*Jarâyujas*, (viviparous, lit., placentalia) in the usual wider sense ; comprising—

(a) *Charmapakṣa pâkṣis*,—leather-winged animals, which are deciduata (*Potaja*) Charaka calls them *Mrigapakṣiṇa* (mammal birds) and distinguishes them from the birds-of-prey proper, in his enumeration of the *Prasahas* (*Sutrasthâna*, Chapter 27). The Bats mentioned are :—

(1) *Valguli*, (flying fox),

(2) The *Pakṣi Virâla*, (flying cat, micro-chiroptera),

(3) The *Bharanda*, (a species of micro-chiroptera, the horse-shoe bat ?)

(4) The *Jalukâ*, (lit., aquatic or amphibious or more probably leech, bat, blood-sucking or vampire bat ?). These are placed among carnivorous animals.

(b) The *Vilesaya Jarâyujas*, mammals that live in holes or burrows, including various species of Rodents and Insectivora, which are named. Eighteen different varieties of mice are specified (Susruta, *Kalpasthâna*, Chapter 6).

(c) *Parnamrigas*, arboreal mammals, comprising some Rodents (squirrels etc.), a wild cat, the sloths and the apes (वानर).

(*d*) Non-carnivorous Quadrupeds (अक्रव्याद:) :—

(1 *Janghâlas*, lit., strong-legged quadrupeds, frequenting hilly and jungly tracts, comprising various species of deer (non-carnivorous wild animals, अक्रव्याद).

(2) *Kulechara* mammals, grazing on the banks of rivers, and frequenting marshy places, comprising the elephant, the rhinoceros, the gaveya (Bos gavæus) the buffalo, the hog and also several species of deer (which live in well watered lands). These are also non-carnivorous (अक्रव्याद)

(3) *Grâmyas*, (lit., living in or near villages), non-carnivorous domesticated quadrupeds, some with undivided hoof, others with cloven hoof,—comprising the horse, the mule, the ass, the camel, the cow, the goat, the sheep, etc. These are all non-carnivorous. The dog and the cat are not mentioned in the list.

(*e*) Carnivorous quadrupeds, *Guhâsaya* (living in natural caves or hollows, carnivorous *Kravyâda*),—comprising the lion, the tiger, the wolf (of the dog-class), the hyena, the bear, the panther, the cat, the jackal, etc. The carnivora were, termed *Vyâlas* or *Kravyâdas*, and the herbi-vora *Pasus* (in a wider sense).

(*f*) Man.

The term *Jarâyuja*, in a wider sense came to mean 'viviparous' and included the above orders of animals. But the Jainas used the term *Jarâyuja* in a narrower sense to mean only those viviparous animals which come out at birth with the placenta (a-deciduata). The deciduata (including the Proboscidea, the Rodentia, the Insectivora, the Chiroptera, etc.) were termed, *Potaja*, lit., viviparous animals born without placenta. Man, the apes and the carnivora are, however, reckoned with the *Jarâyuja* (viviparous, born with placenta). Perhaps the after-birth was observed in these cases, whereas the *Potajas* (deciduata) may have been erroneously conceived to throw off no placenta.

Lâdyâyana appears to have made a special study of the classification of *kitas* (Insects and Reptiles) and is quoted by Dalvana as a great authority on the subject.

The various forms (रूप) of *kitas* are to be distinguished from one another by peculiarities in the following marks :—

(1) Dottings or markings, (2) wings, (3) pedal appendages, (4) mouth, with antennæl or nippers,—मुखसन्दंश, Dalvana, (5) claws, (6) sharp, pointed, hairs or filaments (7) stings in the tails, (8) hymenopterous character (संश्लिष्टै: पत्ररोमभि:) (9) humming or other noise, (10) size, (11) structure of the body, (12) sexual organs (this is how I interprot *linga* here), and (13) poison and its action on bodies.

cf. कटुभि: विन्दुलेखाभि: पत्रै: पादै: मुखै: नखै:
शूकै: कण्टकलांगलै: संश्लिष्टै: पत्ररोमभि: ।
स्वनै: प्रमाणै: संस्थानै लिङ्गैश्चापि शरीरगै:
विषवीर्य्यैश्च कीटानां रूपज्ञानं विभाव्यते ॥

Quoted from Lâdyâyana by Dalvana, *Kalpasthâna*, chapter 8).

APPENDIX C.

HINDU PHYSIOLOGY AND BIOLOGY.

SECTION I.

METABOLISM.[1]

The food that we eat contains five classes of organic compounds. From their radicles or predominant elements, the substances are named Earth-compounds, *Ap*-compounds, *Tejas*-compounds, Váyu-compounds and Âkâsa-compounds. The Earth-compounds supply the hard formed matter of the body, the Tejas-compounds give the animal heat (or the metabolic heat), the Váyu-compounds are the sources of the motor-force in the organism, the Ap-compounds furnish the watery parts of the organic fluids, and the Âkâsa-compounds contribute to the finer etheric essence which is the vehicle of the conscious life.

Roughly speaking, the Earth-compounds answer to the nitrogen compounds in the food, the Tejas-compounds to the hydro-carbons (heat-producing), and the Váyu-compounds to the carbo-hydrates (dynamic). The Ap-compounds are the watery parts of food and drink. The flesh, for example, is a tissue composed principally of the Earth-compounds, the fat of the Earth and Ap-compounds, the bones of earth, Váyu and Tejas compounds. Different operations of the metabolic heat (perhaps different digestive fluids are also meant) are required to digest the different substances in the food.

The course of metabolism is described as follows: The entire alimentary canal is called the Mahâsrotas (the great channel).

The food goes down the gullet by the action of the bio-motor force, the *Práṇa-Váyu*.

In the stomach (आमाशय) the food becomes mixed up, first with a gelatinous mucus (फेणीभूतं कफं) which has a saccharine taste, and then gets acidulated by the further chemical action of a digestive juice (विदाहादम्लतां गतः —evidently the gastric juice is meant). Then the bio-motor force, the *Samána Váyu*, begins to act and drives down the chyme, by means of the *Grahaṇi Nâḍí* to the *Pittâsaya* (duodenum, lit. bile-receptacle) and thence to the small intestines (the आमपक्वाशय). In these, the bile (or rather the digestive substance in the bile, as opposed to the colouring element) acts on the chyme and converts the latter into chyle (रस), which has at first a *katu* taste (pungency). This chyle contains in a decomposed and metamorphosed condition all the organic compounds, *viz.*, tissue-producing Earth-compounds, water-parts or Ap-compounds, heat-producing Tejas-compounds, force-producing Váyu-compounds, and, lastly, finer etheric constituents which serve as the vehicle of consciousness. The essence of chyle (सूक्ष्मभाग) from the small intestines is driven by the bio-motor force, the *Práṇa Váyu*, along a Dhamani trunk (cf. the thoracic duct) first to the heart (which is a great receptacle of chyle), and thence to the liver (and the spleen); and in the liver, the colouring substance in the bile acts on the essence of chyle, especially on the Tejas-substance therein, and imparts to it a red pigment, transforming it into blood. But the grosser part of chyle (स्थूल भाग) proceeds along the Dhamanis, being driven by the bio-motor force, the *Vyána Váyu*, all over the body.

When the blood has been formed, the essence of chyle in the blood, acted on by Váyu (bio-motor force) and Mâmsâgni (the flesh-forming metabolic heat), forms the flesh-tissue, the Earth-compound of the food substance especially contributing to this tissue. Of the flesh-tissue thus formed, the grosser part goes to feed or replenish the flesh-tissue

[1] Extract from my monograph in Dr. Ray's *Hindu Chemistry* Vol. II,

all over the body. The finer essence of flesh in the blood in the chyle, acted on again by Vâyu (bio-motor current) and the fat-forming metabolic heat (मेदोऽग्नि) in the menstruum of lymph (कफं समाश्रित्य), receives viscosity and whiteness, and produces the fatty tissue, the Earth-compounds and Ap-compounds of the food specially contributing to the product. This fat in the chyle (or blood), or rather the grosser part of it, replenishes the fatty tissue of the body, but the finer essence of fat *in* the flesh *in* the blood *in* the chyle, acted on by *Vâyu* (bio-motor current) and the marrow-forming metabolic heat, in the menstruum of lymph (श्लेष्मणावृत), becomes hard (crystalline), and forms bone, the Earth, Vâyu and Tejas compounds contributing principally to the product. The essence of the fat fills the hollow channels of the bones, and acted on again by bio-motor *Vâyu* and metabolic heat, becomes transformed into marrow. The marrow is similarly transformed into the semen, which is conveyed down by means of a pair of *Dhamanis* or ducts (द्वे शुक्रवहे), lodged in its receptacles (शुक्रधरा—वृषणौ) and discharged by means of another pair of ducts (द्वेविसर्गाय). The semen or rather all the elements in their finer essence, give off *ojas* which returns to the heart, the receptacle of chyle and blood, and again floods the body, and sustains the tissues, thus completing the wheel or self-returning circle of metabolism (परिवृत्तिस्तु चक्रवत् cf. Charaka and Vâgbhata).

It is to be noted that, throughout, the fluid in the chyle or blood acts as the menstruum, though occasionally, the lymph, which is itself a derivative from the chyle, is added, as in the case of the fatty tissue and the bones; and that each preceding element or constituent of the body (धातु—शरीरारम्भक धातु) takes up the proper organic compounds from the food chyle to form the next element or tissue. Throughout also, the chemical changes are due to the metabolic heat which breaks up the compounds and recombines, but the operations and even the vehicles perhaps of this heat are different. For example, these heat-corpuscles in the biliary ducts produce the bile, but the bile-secretion is supposed to contain two distinct substances: (1) a digestive fluid in the duodenum (पित्ताशय) which acts on the chyme to produce the chyle (अन्नस्य पक्तृ पाचकाख्यं पित्तं); and (2) a colouring bile-substance in the liver which adds a red pigment to the chyle, and transforms it into blood (रञ्जकाख्यं पित्तं). Besides, there are three other biles, of which the aqueous humour in the eye is supposed to be one (आलोचक पित्तं), helping in the formation of visual images (रूपग्राहकं). This is the view of Dhanvantari and his school, but Âtreya holds there is no evidence that the bile really performs the first (digestive) function, for this can be accounted for by the animal heat arising from the working of the whole bodily machine.

There are three different hypotheses regarding the course of metabolism and the successive transformations of the chyle (क्षीरदधिन्याय—केदारीकुल्यान्याय—खलेकपोतन्यायेति त्रिधा धातु पोषणक्रमः— Chakrapâṇî, Bhânumati, Sutrasthâna, XIV, 10; also his commentary on Charaka, Sutrasthâna, XXVIII), but my account is based on the second hypothesis which has the preference of Chakrapâṇî (स्वरस:). It may be added as a curiosity that each element of the body (धातु) under the metabolic heat is supposed to give off a finer essence (सूक्ष्मभाग) which serves as the material of the next succeeding element, and a dross (मल) which forms some of the excreta in the body (including the nails, the hair &c.), besides retaining its own substance (the gross or main part) which is driven along by the Vâyus (biomotor or vital currents), or by the *srotas*, to its destination in the body.

Some idea of circulation appears to have been entertained, for the heart which receives, and then sends down, the chyle through the *Dhamanis* gets it back transformed into blood, and the *ojas* also proceeds from the heart and returns to it along with the chyle and the blood.

(Cf. Vágbhata ताः हृत्स्थाः शिराः रसात्मकं श्रोजः श्रभिवहन्त्यः)। पञ्चभूतात्मके देहे श्राहारः पाञ्चभौतिकः। विपक्वः पञ्चधा सम्यग् गुणान् स्वानभिवर्द्धयेत्। Susruta, *Sutrasthána*, Chap. 46, cf. also, वियत्पवनजाताभ्यां वृद्धिमाप्नोति मारुतः। श्राग्नेयमेव यद्द्रव्यं तेन पित्तमुदीर्यते। *Ibid*, Chap 41. भौमाप्याग्नेयवायव्याः पञ्चोष्माणः सनाभसाः। पञ्चाहारगुणान् स्वान् स्वान् पार्थिवादीन् पचन्त्यनु। यथास्वं ते च पुष्णन्ति पक्त्वा भूतगुणान् पृथक्। पार्थिवाः पार्थिवानेव शेषाः शेषांश्च देहगान्। श्रतिरिक्ता गुणा रक्ते वह्नेर्मांसे तु पार्थिवाः। मेदस्यपां भुवश्चास्थि पृथिव्यनिलतेजसां। Charaka quoted by Dalvana. श्रादौ षड्रसमप्यन्नं मधुरीभूतमीरयेत्, फेणीभूतं कफं यातं विदाहादम्लतां गतः। वायुना समानाख्येन ग्रहणीमभिनीयते। षष्ठी पित्तधरा नाम या कला परिकीर्त्तिता। श्रामपक्वाशयान्तःस्था ग्रहणी साऽभिधीयते। श्रग्न्यधिष्ठानमन्नस्य ग्रहणाद् ग्रहणी मता। भुक्तमामाशये रुद्धा सा विपाच्य नयत्यधः। बलवत्यबला त्वन्नमाममेव विमुञ्चति।...श्रन्नस्य पक्तृ पित्तन्तु पाचकाख्यं पुरेरितम्। दोषधातुमलादीनामुष्मेत्यात्रेयशासनम्।......तेजोरसानां सर्वेषामम्बुजानां यदुच्यते, पित्तोष्मणा सरागेण रसो रक्तत्व मृच्छति। वाय्वग्नितेजसा युक्तं रक्तं मांसत्व मृच्छति। श्लेष्माणं च समाश्रित्य मांसं वाय्वग्निसंयुतम्, स्थिरतां प्राप्य शौक्ल्यं च मेदो देहेऽभिजायते। पृथिव्यग्न्यनिलादीनां सङ्घातः श्लेष्मणावृतः, खरत्वं प्रकरोत्यस्य जायतेऽस्थि ततो नृणाम्। करोति तत्र सौषिर्यमस्थ्नां मध्ये समीरणः। मेदसा तानि पूर्यन्ते स्नेहो मज्जा ततः स्मृतः। तस्मान्मज्ज्ञश्च यः स्नेहः शुक्रं संजायते ततः। Charaka-Dridhavala Samhitâ quoted by Aruna in his commentary on Vágbhata.

यथा केदारनिपक्तं कुल्याजलं प्रत्यासन्नां केदारीमाप्लावयति। तथा रस एव प्रथमं रक्तं प्लावयति। तत्र रक्तस्थान सम्बन्धात् रक्तसादृश्यं रक्तव्यपेदश्यंच श्रनुभवति। रक्तं च रक्तसमानेन स्तोकेनांशेन श्रस्त्रं पोषयति। ततो रक्त माप्लाव्य मांसमाप्लावयति, एवमुत्तरोत्तरधातून् रसएव प्लावयति। (Chakradatta Bhánumati). This passage shows that the 'venous blood' was conceived to be chyle-essence mixed with blood, and that the circulation of the chylo, so far as it was held to contribute its quota to the constituent elements and tissues of the body, was really supposed to be identical with the circulation of the blood (ततो रक्तमाप्लाव्य मांसमाप्लावयति). This will be abundantly clear from the following account of the course of the chyle and the blood :

ततः सारभूतस्याहाररसस्य द्वौ भागौ भवतः। स्थूलः सूक्ष्मश्च...ततः सूक्ष्मोभागः प्राणवायुना-प्रेरितो धमनीमार्गेण शरीरारम्भकस्य रक्तस्य स्थानं यकृत्-प्लीहरूपं गत्वा तेन सह मिलितोभवति। ततः प्राक्तन रक्तधातौ एव तिष्ठति।...ततः सारभूतस्य श्राहाररसस्य द्वौ भागौ भवतः। स्थूलः सूक्ष्मश्च। स्थूलो भागो रञ्जकाख्येन पित्तेन रक्तीकृतः शरीरारम्भकं रक्तं पोषयन् व्यानवायुना प्रेरितोधमनीभिः सञ्चरन् सकलशरीरगतानि रुधिराणि पुष्णाति। ततः सूक्ष्मोभागः व्यानवायुनाप्रेरितो धमनीभिः शिराभिश्च शरीरारम्भकाणि मांसानि याति। *et seq.*

This finer essence of chyle which nourishes the flesh is also carried in the blood, on the irrigation channel hypothesis (केदारी-कुल्यान्याय).

SECTION 2.

THE CIRCULATORY SYSTEM.

The standing puzzle of Hindu anatomy and physiology is the classification of the *Siras*, *Dhamanis*, *Srotas*, the channels, passages, and ducts in the body including the arteries, veins, nerves, lymphatic vessels, etc. The difficulty was felt by the ancient observers themselves. Some were of opinion that the *Dhamanis* and *Srotas* are only modifications of the *Siras*, and that the division is artificial. Susruta, however, contends that

they are distinct, because they can be traced to different roots and have different functions ; they are apt to be confounded, only because they are minute, juxtaposed, and similar in function. (Susruta, *Śārīrasthāna*, Chapter IX). Charaka also accepts the established division, but points out that the numbers as estimated are conjectural (अनिर्देश्यमतः परं तर्क्यमेव *Śārīrasthāna*, Chapter VII).

The *Śiras*, *Dhamanīs* and *Śrotas* form net-works (जालानि) of cords, fibres, passages, which in the fœtus take their rise from the umbilical cord, and proceed, upwards to the heart and head, downwards to the kidneys and rectum, and outwards to the trunk and limbs. These three classes comprise all the vehicles or conductors of the fluids, secretions and currents in the bodily system.

The *Śrotas* (*currents*). This is a peculiarity of Hindu physiology. The chyle, the blood, the Vāyu, the metabolic fluid (पित्त), the lymph, the fat, the marrow, in every part of the body, is supposed to be connected by means of subtle currents (*Śrotas*) with the same kind of fluid (or tissue) in every other part. Without supposing such special connections, many pathological phenomena cannot be explained.

The *Śiras* are divided into four groups : (1) the arteries for conducting the blood, (2) the lymphatics for conducting the lymph, (3) a class of bile ducts, and (4) a class of ducts for the *vāyus*, the currents which work the automatic and reflex machinery of the living organism. In each group, there are 10 trunk *Śiras*, which sub-divide into 175 cords, and further ramify minutely all over the body, even as a net-work of minute fibrils covers the leaf of a tree.

The functions of the different groups of *Śiras* are to conduct or transmit the (arterial) blood, the lymph, the bile, and the (vital) *vāyu* currents respectively to the different parts of the body. The *Śiras* are compared to the conduits of the flowing water in a pleasure-house (a garden), or the channels of irrigation that flood a field. The conduction (or transmission) of the fluids and currents is effected by an alternate dilation and contraction of the vessels, the systolic movement differing according to the nature of the fluid propelled :

(सप्त शिराशतानि भवन्ति याभिरिदं शरीरमाराम इव जलहारिणीभिः केदारइव च कुल्याभिरुपस्निह्यते अनुगृह्यते च आकुञ्चनप्रसारणादिभिर्विशेषैः। द्रुमपत्रसेवनीनामिव तासां प्रतानाः। तासां नाभिमूलं ततश्च प्रसरत्यूर्द्ध्वं अधस्तिर्य्यक् च। तासां मूलशिराश्चत्वारिंशत्। तासां वातवाहिन्यो दश पित्तवाहिन्यो दश कफवाहिन्यो दश दश रक्तवाहिन्यः *Susruta*, *Śārīrasthāna*, Chap. VII.)

The *Dhamanīs* in the fœtus take their rise from the umbilical cord, thus bringing nourishment from the mother. They are divided into three groups : (*a*) ten trunks or cords going up to the heart, and thence to the head, (*b*) ten going down to the intestines, kidneys and rectum, and (*c*) four branching obliquely or sidewise, and ramifying over the whole body. In a general way, it may be stated that the *Dhamanīs* comprise (1) the veins, (2) the nerves (including the sympathetic system), (3) the chyle-ducts (including the thoracic duct) as distinguished from the other lymphatics, which are classed as *Śiras*, (4) the ducts for urine, sweat, and other secretions, and (5) lastly, certain classes of bile-ducts and conductors of Vāyu currents, possibly those connected with the venous system and the chyle-ducts.

The first group of *Dhamanīs*:—Special features :—Each of the ten ascending Dhamanīs, on reaching the heart, trifurcates, and proceeds to the head. Of these fibres, one pair is engaged in conducting each of the four sensory currents (those of sound, colour, taste and smell), *from the sense-organs, as Charaka and Susruta must have supposed, to the heart, which is for them the seat of consciousness* (हृदयं विशेषेण चेतनास्थानम्, Susruta,

Sárirasthána, Chapter IV, हृदयं चेतनाधिष्ठानमेकम् Charaka, *Sárirasthána*, Chapter VIII). Other Dhamanîs, also in pairs, are engaged in conducting automatic (or voluntary) motor currents, (*e.g.*, the currents concerned in respiration, yawning, sleeping and waking), or the secretions of the lachrymal and mammary glands.

The second group of *Dhamanis* :—Special functions :

The descending *Dhamanîs* go down to the intestines, kidneys, bladder and rectum, and their special function is to convey, in pairs as before, urine and other secretions and excreta. They also convey the chyle from the small intestines to the ascending as well as the ramifying *Dhamanis*. In addition, some of them convey sweat to the ramifying *Dhamanîs*.

The third group : Special functions. The remaining four *Dhamanîs* ramify obliquely over the body into millions of fibres and fibrillæ, which terminate in the pores of the skin. From all parts of the periphery, they conduct the sensory currents of touch to the central organ of the heart (including the internal organic sensations). Being connected with the pores of the skin, they conduct sweat outwards, and the influences of baths, embrocations, and fomentations inwards.

Other *Dhamanîs* serving as chyle-ducts and (venous) blood-vessels :—Besides the special functions performed by the three groups, there is one characteristic function common to certain classes of *Dhamanis* which are found in all the three groups—*viz.*, the conduction of chyle and (venous) blood, *i.e.*, of blood in the state of chyle, before it gets its red pigment from the liver. It may also be added that the three principal elements of the body, *Váyu* (vital current), *Pitta* (bile, or rather the fluid animal heat which produces metabolism, पाक, and flows to all the parts of the body by means of connective passages), and *Kapha* (lymph), make use of the *Dhamanis* as well as the *Śiras* and *Śrotas*, *i.e.*, of all manner of conductors in the organism (cf. Charaka, वातपित्त श्लेष्माणां पुनः सर्वशरीरचराणां सर्वाणि स्रोतांसि अयनभूतानि *Vimánasthána*, Chapter V).

The functions of the *Śiras* may, therefore, be stated as follows :—

(1) The conduction of blood from the liver and spleen, red blood (what may be called the arterial blood of this system of physiology) to the heart, head, trunk, limbs, etc.

(2) Common functions of all connective passages, *viz.*, the conduction of *Váyu* (vital current), *Pitta* (metabolic fluid), and *Kapha* (lymph).

The different classes of *Dhamanîs* with their functions are :—

(1) The nerves : (*a*) eight sensory (central) nerves for the four special senses other than touch, (*b*) twelve motor nerves partly for voluntary and partly for automatic movements, and (*c*) the nerves of touch and organic sensation, including the sympathetic nerves.

(2) The chyle-ducts, conductors of (venous) blood,—conveying the chyle before it is transformed into blood in the liver (and the spleen).

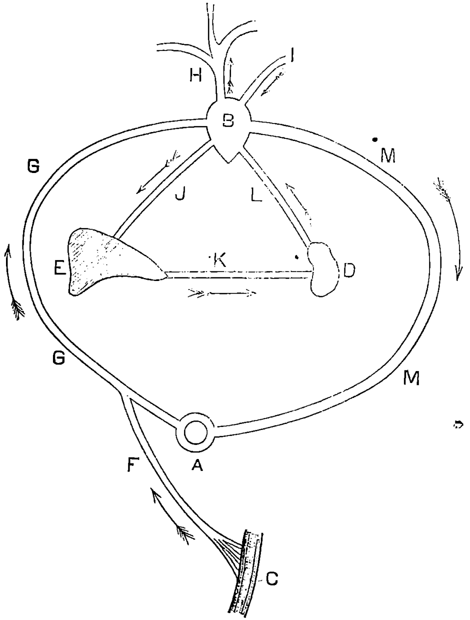
(3) The classes of *Dhamanîs*, which, in common with the *Śiras* and *Śrotas*, conduct *Váyu*, *Pitta* and *Kapha*,—the prime movers of the organic life.

ŚIRAS AND DHAMANÎS AS BLOOD-VESSELS.

THE CIRCULATORY SYSTEM.

The anatomical arrangement of the *Śiras* and *Dhamanis* as conceived in this system of physiology is so fanciful and obscure (Charaka himself states that it is unascertainable and questionable) that it is with considerable diffidence that I attempt to reproduce in a chart the main features of the vascular and circulatory system. At the outset, I would premise that the mistake as to the relative position of the heart and the liver in man, which

lasted till the middle of the sixteenth century in Europe and took a Vesalius to correct, was impossible to the Hindu anatomists, who habitually practised dissection on human corpses.



Conjectural Restoration of the Diagram of the central circulation of the Śiras and Dhamanîs after Charaka and Susruta. The obliquely branching Dhamanîs, and the ramifications of the Śiras are not shown.

(a) Navel,—the fœtal source of Siras and Dhamanis,—may be taken as the starting point of the circulatory system.

(b) Heart (पुंडरीकेन सदृशं हृदयं स्यादधोमुखम् । जाग्रतस्तद्विकशति स्वपतश्च निमीलति । Susruta, Śârira-sthâna IV),—the receptacle of the chyle poured into it by the ascending Dhamanîs;—source of the 'life currents' (प्राणवहानि स्रोतांसि), and seat of consciousness;—also supplies to the spleen and liver (venous) blood, or rather chyle mixed with blood, to be transformed

into red (arterial) blood. The heart is also supplied by Śiras with true blood. Cf. प्रसवाभ्यां कफासृग्भ्यां हृदयं पंकजाकृति। शुषिरं स्याद्धोवक्त्रं (संगीतरत्नाकर)

(c) Small intestine (पित्ताशय) which receives the chyme from the stomach (आमाशय), and, with the help of the bile brought from the liver, turns the chyme into chyle.

(d) Spleen, a minor source of blood (or blood vascular gland); on the left below the heart.

(तस्याधोवामतः प्लीहा—Susruta, Chaptor IV).

(e) Liver, the major source of blood; the chyle gets a red pigment in the liver (and spleen) and is converted into true (arterial) blood. The liver is to the right.

(दक्षिणतो यकृत्—Susruta, Śârîrasthâna, Chapter IV).

(f) Dhamanî, conveying chyle from the small intestine to the great Dhamanî trunk (g) that ascends to the heart;—answers to the portal vein and thoracic duct (?)

(g) Dhamanî trunk, ascending from the navel to the heart; answers to the inferior Vena Cava.

(h) Dhamanî ascending from the heart to the head,—and trifurcating;—answers to the superior Vena Cava.

(i) Also, Dhamanî ascending from the heart, but brings back the (venous) blood to the heart (Pulm. Artory ?)

(j) Also, a Dhamanî, descending from the heart, and conveying the chyle and venous blood from the heart to the liver, where the blood takes a red pigment.

(k) Śira, connecting the liver with the spleen,—carrying the red blood from the liver to the spleen (Sp. vein).

(l) Śira, from the spleen to the heart, carrying the red blood to the heart.

(m) Śira, bringing red ("arterial") blood from the heart to the navel, the starting point, answering to the aorta.

N.B.—The Śiras ramify from the liver and the spleen, and supply the trunk, head and limbs, with red (arterial) blood. Four Dhamanî trunks also, for the trunk and limbs, issue from the navel. They ramify into veins and capillary vessels (as also nerve fibres and fibrils) and carry chyle and (venous) blood over the entire system.

It is clear that Charaka and Susruta had no idea of the part played by the lungs in the purification of the blood. The liver converts the 'venous' blood in this system into true ('arterial') blood, and along with the spleen serves as a basis of discrimination between a Śira and a Dhamanî, thus illustrating Susruta's statement that the distinction between these two kinds of blood vessels must be accepted as real, inasmuch as they have different sources and different functions.

तासान्तु नाभिप्रभवानां धमनीनामूद्ध्र्वंगा दश दश चाधोगामिन्यश्चतस्रस्तिर्यंगाः ऊद्ध्र्वंगास्तु हृदयमभिप्रपन्ना स्त्रिधा जायन्ते। अधोगमास्तु पित्ताशयमभिप्रतिपन्नास्तत्रस्थमेवान्तपानरसं विपक्वं औष्ण्याद् विरेचयन्त्यः अभिवहन्त्यः शरीरं तर्पयन्ति चोद्ध्र्वंगतानां तिर्यग्गतानां रसस्थानमभिपूरयन्ति (Susruta, Śârîrasthâna, Chapter IX). तत्र पांचभौतिकस्य आहारस्य सम्यक् परिणतस्य यस्तेजोभूतः सारः परमसूक्ष्मः स रस इच्छते। तस्य च हृदयं स्थानम्। स हृदयाच्चतुर्विंशतीः धमनीरनुप्रविश्य ऊद्ध्र्वंगा दश दश चाधेगामिन्यश्चतस्रस्तिर्यग्गाः कृत्स्नं शरीरं अहरहस्तर्पयन्त। तस्य शरीरमनुधावतोऽनुमानाद् गतिरुपलक्षयितव्या। स खल्वाप्योरसः यकृत्प्लीहानौ प्राप्य रागमुपैति। (*Ibid*, Chapter IV). रंजितास्तेजसास्त्वापः शरीरस्थेन देहिनां रक्तमित्यभिधीयते। (*Ibid*, Sutrasthâna, Chapter XIV).

सप्तशिराशतानि भवन्ति। याभिरिदं शरीरम् आराम इव जलहारिणीभिः केदार इव कुल्याभिरुपस्निह्यते आकुञ्चनप्रसारणादिभिर्विशेषैः। नाभ्यां सर्व्वा निबद्धास्ताः प्रतन्वन्ति समन्ततः। तासां मूलशिराः चत्वारिंशत्तासां वातवाहिन्यो दश पित्तवाहिन्यो दश कफवाहिन्यो दश दश च रक्तवाहिन्यः। तासान्तु वातवाहिनीनां वातस्थानगतानां पञ्चसप्ततिशतं भवति। रक्तवाहिन्यश्च यकृत्प्लीह्नोरेव। तत्र वातवाहिन्यः शिराः एकस्मिन् सक्थ्नि पञ्चविंशतिः। एतेन इतरसक्थिबाहू च व्याख्यातौ। विशेषतस्तु कोष्ठे पृष्ठे चोदरे वक्षसि जत्रुणः ऊर्द्ध्वं एवं रक्तवहाः कफवहाश्च धातूनां पूरणं वर्णं स्पर्शज्ञानमसंशयम्। स्वाः शिराः सञ्चरद्रक्तं कुर्य्याच्चान्यान् गुणानपि (Śârîrasthâna, Chapter VIII). द्वितीया (कला) रक्तधरा नाम। तस्यां शोणितं विशेषतस्तु शिरासु यकृत् प्लीह्नोश्च भवति (*Ibid*, Chapter IV). षष्ठी (कला) पित्तधरानाम। चतुर्विधमन्नपानमुपयुक्तमामाशयात् प्रच्युतं पक्वाशयोपस्थितं धारयति। स्रोतस्तद् विज्ञेयं शिराधमनीवर्ज्जितं*।...तानि (स्रोतांसि) प्राणान्नोदकरसरक्तमांसमेदोमूत्रपुरीषशुक्रार्त्तववहानि। तत्र प्राणवहे द्वे। तयोर्मूलं हृदयं रसवाहिन्यश्च धमन्यः। उदकवहे द्वे। तयोर्मूलं तालुक्लोम (*Kloma*, gall-bladder) च। तत्र विद्धस्य पिपासा। अन्नवहे द्वे। तयोर्मूलं आमाशयः अन्नवाहिन्यश्चधमन्यः। रसवहे द्वे। तयोर्मूलं हृदयं रसवाहिन्यश्च धमन्यः। रक्तवहे द्वे। तयोर्मूलं यकृत् प्लीहानौ रक्तवाहिन्यश्च धमन्यः। मांसवहे द्वे। तयोर्मूलं स्नायुत्वचं रक्तवाहिन्यश्च धमन्यः।

SECTION 3.

THE NERVOUS SYSTEM IN CHARAKA.

The Nerves. Dhamanîs as nerves :—The anatomy of the nervous system in Charaka and Susruta, can be more clearly and confidently restored. The Dhamanîs that ascend from the heart divide into 30 cords, of which 20, *i.e.*, 10 pairs, are cranial nerves, and the other 10, or 5 pairs, are engaged in conveying vital currents, metabolic fluid, lymph, blood and chyle.

The cranial nerves are : (1) four pairs of sensory nerves carrying sensory impulses from the sense-organs to the heart, *viz.*, the optic, auditory, olfactory, and gustatory nerves and (2) six pairs of motor (or mixed nerves), *e.g.*, three pairs of motor nerves for the eye (Motores oculorum, Pathetic and Abducentes) working the Levator Palpebræ and other muscles of the orbit; one pair of motor nerves for articulation, the hypoglossal; one pair of motor nerves for the larynx, (the Pneumo-gastric), and another pair connected with mammæ and (in the case of the male) the seminal duct. It is further stated that other motor or sensori-motor impulses are carried by some of these cranial nerves, *viz.*, those which produce sighs and sobs, yawning, laughter and hunger. Evidently some of the functions of the pneumogastric and the spinal accessory nerves are intended, as also of the phrenic and other nerves of the cervical plexus.

Of the 30 descending Dhamanîs, 10 (or 5 pairs) are conductors of blood, chyle, vital current, metabolic fluid and lymph, and the remaining 20 are spinal nerves (specially the nerves of the sacro-coccygeal and sacral plexuses, if not also of the lumbar plexus). The obliquely branching Dhamanîs, so far as they are nerves, comprise the brachial and the lumbar plexus, and divide and sub-divide hundred-fold, thousand-fold, till they ramify into fibrillæ round the pores of the skin. They carry to the heart cutaneous sensations, external as well as internal. A fibril (सूक्ष्मनाड़ी) is said to be as minute as the thousandth part of a hair (लोम्नः सहस्रभागेन तुल्यासु प्रचरत्यणुः—*Panchadasi*).

ऊर्द्ध्वगाः शब्दरूपरसगन्धप्रश्वासोच्छ्वासविजृम्भितक्षुद्धसितकथितरुदितादीन्विशेषान् अभिवहन्त्यः शरीरं धारयन्ति। तास्तु हृदयमभिप्रतिपन्नास्त्रिधा जायन्ते तास्त्रिंशत्। तासान्तु वातपित्तकफशोणितरसान्। द्वे द्वे वहतस्ता दश। शब्दरूपरसगन्धान् अष्टाभिर्गृह्णीते। द्वाभ्यां भाषते। द्वाभ्यां घोषं करोति। द्वाभ्यां

स्वपिति। द्वाभ्यां प्रतिबुध्यते। द्वे च अश्रुवाहिन्यौ। द्वे स्तनसंश्रिते। ते एव शुक्रं नरस्य स्तनाभ्यां अभिवहतः।

तिर्य्यग्गानान्तु चतसृणां धमनीनां एकैका शतधा सहस्रधा चोत्तरोत्तरं विभज्यन्ते तास्त्वसंख्येयाः।

ताभिरिदं शरीरं गवाक्षितं तासां मुखानि रोमकूप प्रतिबद्धानि। यैः स्वेदमभिवहन्ति रसञ्चापि सन्तर्पयन्ति अन्तर्बहिश्च। तैरेव चाभ्यङ्गपरिषेकावगाहालेपनवीर्य्याणि अन्तःशरीरमभिप्रतिपद्यन्ते। त्वचि विपक्वानि तैरेव स्पर्शसुखमसुखं वा गृह्णाति। तास्तु एताश्चतस्रोध मन्यः सर्वाङ्गगताः सविभागा व्याख्याताः। (Susruta Sârîrasthâna, Chapter IX.)

SECTION 4.

THE NERVOUS SYSTEM AFTER THE TANTRAS—PSYCHOPHYSIOLOGY.

In Charaka and Susruta (as in Aristotle) the heart is the central organ and seat of consciousness. But in the Tantric writings (as in Galen), the seat of consciousness is transferred to the brain or rather the cerebro-spinal system. The Soul (the Jiva) has its special seat within the *Brahmarandhra* above the foramen of Monro and the middle commissure, but traverses the whole cerebro-spinal axis, up and down, along the *Sushumna* (the central canal of the spinal cord). The *Brahmadanda* (vertebral column) contains the *Brahma-Nâdi*, the *Sushumna* and the *Manovahâ Nâdi*. The cerebro-spinal axis with the connected sympathetic system contains a number of ganglionic centres and plexuses, (*Chakras, Padmas*) from which nerves (*Nâdîs, Sirâs* and *Dhamanîs*)* radiate over the head, trunk and limbs.

SECTION 5.

GANGLIONIC CENTRES AND PLEXUSES (SYMPATHETIC-SPINAL SYSTEM).

Beginning with the lower extremity, the centres and plexuses of the connected spinal and sympathetic systems may be described as follows :—

(1) The *Adhâra Chakra*, the sacro-coccygeal plexus, with four branches, nine *Angulis* (about six inches and a half) below the solar plexus (*Kanda, Brahmagranthi*); the source of a massive pleasurable æsthesia, voluminous organic sensations of repose. An inch and a half above it, and the same distance below the membrum virile (*Mehana*) is a minor centre called the *Agni-sikhâ*.

(2) The *Svâdhisthâna Chakra*, the sacral plexus with six branches (पलाणि, दलानि leaves), concerned in the excitation of sexual feelings with the accompaniments of lassitude, stupor, cruelty, suspicion, contempt.

(3) The *Nâvi kanda* (corresponding to the solar plexus, *Bhânubhavanam*)—which forms the great junction of the right and left sympathetic chains (*Pingalâ* and *Idâ*) with the cerebro-spinal axis.

Connected with this is the *Manipuraka*, the lumbar plexus with connected sympathetic nerves, the ten branches of which are concerned in the production of sleep and thirst, and the expressions of passions like jealousy, shame, fear, stupefaction.

(4) The *Anâhata Chakra*, possibly the cardiac plexus of the sympathetic chain, with twelve branches, connected with the heart, the seat of the egoistic sentiments, hope, anxiety, doubt, remorse, conceit, egoism, etc.

* The writers of the Yoga and Tantra schools use the term *Nâdi*, by preference, for Nerves. They also mean Cranial nerves when they speak of *Sirâs*, never using the latter term for Arteries, as in the older medical literature.

(5) The *Bháratisthána*, the junction of the spinal cord with the medulla oblongata, which, by means of nerves like the pneumo-gastric, etc., regulate the larynx and other organs of articulation.

(6) The *Laланá Chakra* opposite the uvula, which has twelve leaves (or lobes), supposed to be the tract affected in the production of ego-altruistic sentiments and affections like self-regard, pride, affection, grief, regret, respect, reverence, contentment, etc.

(7) The sensori-motor tract, comprising two Chakras, (*a*) the *Âjná Chakra*, lit. the circle of command (over movements), with its two lobes (the cerebellum), and (*b*) the *Manaschakra*, the sensorium, with its six lobes (five special sensory for peripherally initiated sensations, and one common sensory for centrally initiated sensations, as in dreams and hallucinations).

The *Âjna-vaha Nádis*, efferent or motor nerves, communicate motor impulses to the periphery from this *Âjná Chakra*, this centre of command over movements; and the afferent or sensory nerves of the special senses, in pairs, the *Gandhavahá Nádi* (olfactory sensory), the *Rupavahá Nádi* (optic), the *Sardavaha Nádi* (*auditory*), the *Rasavahá Nádi* (gustatory), and the *Sparaśavaha Nádi* (tactile), come from the periphery (the peripheral organs of the special senses) to this *Manaschakra*, the sensory tract at the base of the brain. The *Manaschakra* also receives the *Manovahá Nádi*, a generic name for the channels along which centrally initiated presentations (as in dreaming or hallucination) come to the sixth lobe of the *Manaschakra*.

(8) The *Somachakra*, a sixteen-lobed ganglion, comprising the centres in the middle of the cerebrum, above the sensorium;—the seat of the altruistic sentiments and volitional control, *e.g.*, compassion, gentleness, patience, renunciation, meditativeness, gravity, earnestness, resolution, determination, magnanimity, etc.; and lastly

(9) The *Sahasrâra Chakra*, thousand-lobed, the upper cerebrum with its lobes and convolutions, the special and highest seat of the *Jiva*, the soul.

गुह्यलिङ्गान्तरे चक्रमाधाराख्यं चतुर्द्दलम् । परमः सहजः...आनन्दः...स्यादैशानादिदले फलं । स्वाधिष्ठानं लिङ्गमूले षट्पत्रं चक्रमस्यच । पूर्व्वादिषु दलेषु फलानि एतानि प्रश्रयः क्रूरता... मूर्च्छा...अवज्ञा स्यादविश्वासः कामशक्ते रिदं गृहम् । नाभौ दशदलं चक्रं मणिपूरसंज्ञं । सुषुप्तिरत्र तृष्णा स्यादीर्षा...लज्जा भयं घृणा मोहः......क्रमात् पूर्व्वादि दलेषु स्यात् भानुभवनञ्च तत् ।

हृदये अनाहतं चक्रं । दलैर्द्वादशभिर्युतं । लौल्यं कापट्यं वितर्कोऽप्यनुतापिता आशा...चिन्ता ...दम्भोवैकल्ल्यं विवेकोऽहंकृतिस्तथा फलान्येतानि । कण्ठेऽस्ति भारतीस्थानं षोडशच्छदं तत्र प्रणव उद्दीप्तः सप्त स्वरा षड्जादयः । ललनाख्यं घण्टिकायां चक्रं द्वादशपत्रकं । दमोमानस्ततः स्नेहः शोकः खेदश्च सम्भ्रम श्चोर्म्मिः श्रद्धा तोषोऽपराधिता । फलानि ललनाचक्रे भ्रूमध्ये द्विदलं चक्रं आज्ञासंज्ञं फलानि च आविर्भावाः सत्त्वरजस्तमसां । तत्र चास्ति मनश्चक्रं षड्दलं तत्फलानि तु । स्वप्नो रसोपयोगश्च घ्राणं रूपोपलम्भनं

स्पर्शनं शब्दबोधश्च पूर्व्वादिषु दलेषु । ततोऽपि षोड़शदलं सामचक्रं । दलेषु षोडश तस्य कलाः षोडश संस्थिताः । कृपाथ मार्द्दवं धैर्य्यं वैराग्यं धृतिसम्पदौ हास्यं रोमाञ्चं विनयो ध्यानं सुस्थिरता ततः । गाम्भीर्य्यमुद्यमोऽक्षोभ मौदार्य्यैकाग्रहे क्रमात् । फलान्युद्यन्ति जीवस्य पूर्व्वादिदलगामिनः । चक्रं सहस्रपत्रन्तु ब्रह्मरन्ध्रे । सुषुम्नया ब्रह्मरन्ध्रमारोहत्यवरोहति । जीवः प्राणसमारूढो रज्ज्वा कोलाटिको यथा । ब्रह्मरन्ध्रे स्थितो जीवः सुधया संप्लुतः । आधाराद्द्व्यङ्गुलादूर्ध्वं मेहनाद्द्व्यङ्गुलादधः अग्निशिखा (चक्रं) चक्रात् तस्मात् (आधारचक्रात्) नवाङ्गुलः देहस्य कन्दोऽस्ति । उत्सेधायामाभ्यां

चतुरङ्गुलः ब्रह्मग्रन्थिरितिप्रोक्तः । (संगीतरत्नाकर as summarised in Dâmodara's Sangita-darpana. *Vide* Sangita-ratnâkara, पिण्डोत्पत्तिप्रकरणं verses 116-144) दीर्घास्थिमूर्द्धपर्य्यन्तं ब्रह्मदन्तेति कथ्यते तस्यान्ते सुषिरं सूक्ष्मं ब्रह्मनाडीति सूरिभिः (उत्तरगीता)—तत् कार्यकायां विश्वग्व्यापिशाखासहस्रवत्या मनोवहनाड्य मूलं तिष्ठति । तस्या अलावुल तकायाइव ऊद्र्ध्वमुखे । एकाशाखा सुषुम्ना इति गीयते । स चौमनोवहा नाड़ी चित्तस्थानं भवति (विज्ञानभिक्षुयोगवार्त्तिक) सुषुम्ना चोद्र्ध्वगामिनी ज्ञाननाड़ी भवेत् (*Jnâna Sankalini Tantra.*) For functions of *Âjnâvahâ Nâdî* and *Manovahâ Nâdi*, also see Sankara Misra's *Upaskâra.*

The cerebro-spinal axis and the heart :—their respective relations to the conscious life :—Vijnânabhikshu, in the passage just quoted, identifies the *Manovahâ Nâdi* (vehicle of consciousness, चित्तस्थानं) with the cerebro-spinal axis and its ramifications, and compares the figure to a inverted gourd with a thousand-branched stem hanging down. The *Sushumna*, the central passage of the spinal cord, is the stem of this gourd (or a single branch). The writers on the Yoga (including the authors of the various Tantric systems) use the term somewhat differently. On this view, the *Manovahâ Nâdi* is the channel of the communication of the *Jiva* (soul) with the *Manaschakra* (sensorium) at the base of the brain. The sensory currents are brought to the sensory ganglia along afferent nerves of the special senses. But this is not sufficient for them to rise to the level of discriminative consciousness (सविकल्पकज्ञानम्) A communication must now be established between the *Jiva* (in the *Sahasrâra Chakra*, upper cerebrum) and the sensory currents received at the sensorium, and this is done by means of the *Manovâha Nâdi.* When sensations are centrally initiated, as in dreams and hallucinations, a special *Nâdi* (*Svapnavahâ Nâdi*), which appears to be only a branch of the *Manovahâ Nâdi*, serves as the channel of communication from the *Jiva* (soul) to the sensorium. In the same way, the *Ajnâvahâ Nâdi* brings down the messages of the Soul from the *Sahasrâra* (upper cerebrum) to the *Ajna Chakra* (motor tract at the base of the brain), messages which are thence carried further down, along efferent nerves, to various parts of the pheriphery. I may add that the special sensory nerves together with the *Manovahâ Nâdi* are sometimes generally termed *Jnânavahâ Nâdi*, lit., channel of presentative knowledge. There is no difficulty so far. The *Manovahâ Nâdi* and the *Ajnâvahâ Nâdi* connect the sensori-motor tract at the base of the brain (*Mânaschakra* and *Ajnâchakra*) with the highest (and special) seat of the soul (Jiva) in the upper cerebrum (Sahasrâra), the one being the channel for carrying up the sensory, and the other for bringing down the motor messages. But efforts of the will (*Âjnâ, Prayatna*) are conscious presentations, and the *Manovahâ Nâdi* must therefore co-operate with the *Ajnâvahâ* in producing the consciousness of effort. Indeed, attention, the characteristic function of *Manas*, by which it raises sense-presentations to the level of discriminative consciousness, implies effort (*Prayatna*) on the part of the soul (*Âtman, Jiva*), an effort of which we are conscious through the channel of the *Manovahâ Nâdi.* But how to explain the presentation of effort in the motor-nerves ? Sankara Misra, the author of the *Upaskâra* on *Kanâda's Sûtras*, argues that the *Nâdis* (even the volitional or motor nerves) are themselves sensitive, and their affections are conveyed to the sensorium by means of the nerves of the (inner) sense of touch (which are interspersed in minute fibrillæ among them). The consciousness of effort, then, in any motor nerve, whether *Ajnâvahâ* (volitional-motor), or *Prâṇavahâ* (automatic-motor), depends on the tactile nerves (or nerves of organic sensation) mixed up with it. Thus the assimilation of food and drink by the automatic activity of the *Prâṇas* implies an (automatic) effort (जीवनयोनिप्रयत्न) accompanied by a vague organic consciousness, which is due to the fact that minute fibres of the inner touch-sense are interspersed with the machinery of the automatic nerves (the *Prâṇavahâ Nâdis*).

यद्यपीन्द्रियं मनोन साक्षात् प्रयत्नविषयः तथापि मनोवहनाडीगोचरेण प्रयत्नेन मनसि कर्म्म द्रष्टव्यं। नाड्यास्तु त्वगिन्द्रियग्राह्यत्वमङ्गीकर्त्तव्यं। अन्यथा प्राणवहनाडीगोचरेण प्रयत्नेन अशित-पीताद्यभ्यवहरणमपि न सम्भवेत्। तत्तदिन्द्रियप्रदेशेन मनःसंयोगमन्तरेण सुखदुःखे न स्यातामेव। यदि मनसि कर्म्म न भवेत् न भवेच्च पादे मे सुखं शिरसि मे वेदना इत्याद्याकारोऽनुभवः।

(Sankara Misra's *Upaskâra*, on Sûtras 14, 15, *Ahnika* 2, Chap. V.)

The Heart. The heart in the older schools is considered to be the seat of waking consciousness. For the heart expands during waking life and contracts during sleep.

Sleep (स्वाप) again is of two kinds (1) dreaming sleep (*swapna, supti*) when the external senses are withdrawn into the heart, but the representative-presentative faculty (मनः, चित्तं) wakes, and (2) dreamless sleep (*suṣupti*) when this last faculty is likewise merged in the mere automatic activity of life.

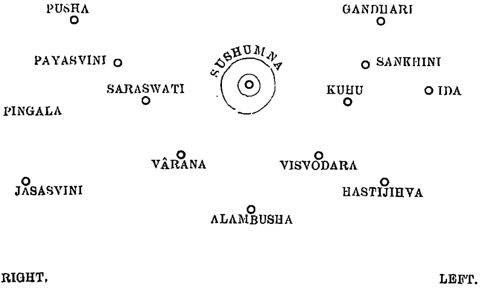
हृदयं पंकजाकृति। सुषिरं स्यादधोवक्त्रं एतच्च चेतनास्थानं। निमीलति स्वपित्यात्मा जागर्त्ति विकशत्यपि। द्वेधा स्वप्नसुषुप्तिभ्यां स्वापः। बाह्येन्द्रियाणि चेत् लीयन्ते हृदि जागर्त्ति चित्तं सुप्तिस्तदोच्यते। मनश्चेत् लीयते प्राणे सुषुप्तिः स्यात्तदात्मनः—(*Sangita-ratnâkara*).

SECTION 6.

NERVE CORDS AND FIBRES (SYMPATHETIC-SPINAL SYSTEM).

Nerve-cords and Fibres—Cranial and spinal nerves, and the connected sympathetic nerves:—With the writers on the Yoga, all the *Śiras*, and such of the *Dhamanîs* as are not vehicles of vital current, metabolic fluid, lymph, chyle or blood, are cranial nerves, and proceed from the heart through the spinal cord to the cranium. These cranial nerves include pairs for the larynx and the tongue, for the understanding and use of spech, for the raising and lowering of the eyelids, for weeping, for the sensations of the special senses, etc.—a confused and unintelligent reproduction of Susruta's classification. But the enumeration of the spinal nerves with the connected sympathetic chain and ganglia, is a distinct improvement on the old anatomists. The following plan attempts to give a rough idea of the relative position of the principal nerves of the sympathetic-spinal system.

TRANSVERSE SECTION.



The *Suṣumnâ* is the central cord in the vertebral column (ब्रह्मदण्ड, मेरु). The two chains of sympathetic-ganglia on the left and the right are named *Idâ* and *Pingalâ* respectively. The sympathetic nerves have their main connection with *Suṣumnâ* at the solar plexus (भानुभवनं, नाभिचक्र in the कन्द, नाभिकन्द or ब्रह्मग्रन्थि). Of the seven hundred nerve-cords of the sympathetic-spinal system (भूरितरा : Sangîta-ratnâkara), the fourteen most important are :—

(1) *Suṣumnâ*, in the central channel of the spinal cord.

(2) *Idâ*, the left sympathetic chain stretching from under the left nostril to below the left kidney,—in the form of a bent bow.

(3) *Pingalâ*, the corresponding chain on the right.

(4) *Kuhu*, the pudic nerve of the sacral plexus, to the left of the spinal cord.

(5) *Gandhârî*, to the back of the left sympathetic chain,—supposed to stretch from below the corner of the left eye to the left leg. It was evidently supposed that some nerves of the cervical plexus came down through the spinal cord and joined on to the great sciatic nerve of the sacral plexus.

(6) *Hastijihvâ*, to the front of the left sympathetic chain stretching from below the corner of the left eye to the great toe of the left foot, on the same supposition as before. Pathological facts were believed to point to a special nerve connection between the eyes and the toes.

(7) *Sarasvatî*, to the right of *Suṣumnâ*, stretching up to the tongue (the hypo-glossal nerves of the cervical plexus).

(8) *Puṣâ*, to the back of the right sympathetic chain, stretching from below the corner of the right eye to the abdomen (a connected chain of cervical and lumbar nerves).

(9) *Payasvinî*, between Puṣâ and Sarasvatî, auricular branch of the cervical plexus on the right.

(10) *Sankhinî*, between Gandhârî and Sarasvatî, auricular branch of the cervical plexus on the left.

(11) *Yaśasvinî*, to the front of the right sympathetic chain, stretching from the right thumb to the right leg (the radial nerve of the brachial plexus continued on to certain branches of the great sciatic).

(12) *Vârunâ*, the nerves of the sacral plexus, between Kuhu and Jasasvinî, ramifying over the lower trunk and limbs.

(13) *Visvodara*, the nerves of the lumbar plexus, between Kuhu and Hastijihva, ramifying over the lower trunk and limbs.

(14) *Alambuṣa*, the coccygeal nerves, proceeding from the sacral vertebræ to the urino-genitary organs.

(*Vide* Sangîta-ratnâkara, स्वराध्याय, पिण्डोत्पत्तिप्रकरणम् slokas 144-156. Also, the Yogârṇava.)

SECTION 7.

AUTOMATIC AND REFLEX ACTIVITY OF THE ORGANISM —THE FORTY-NINE *VAYUS*.

Charaka describes *Vâyu* as that which keeps the machine of the body at work, the prime-mover, the impelling force which sets in motion the organs (including the senses and the mind), which arranges the cells and tissues, and which unfolds or develops the fœtal structure out of the fertilised ovum. Charaka and Susruta notice the five chief *Vâyus* with their functions in the maintenance of the animal life. Susruta mentions

Prāṇa as having its course in the mouth, and concerned in deglutition, hiccough, respiration, etc., *Udāna* as concerned in articulation and singing, *Samāna* as digesting the food in the stomach in conjunction with the animal heat, *Vyāna* as coursing all over the body, driving the chyle and causing the flow of blood and sweat, and *Apāna* as having its seat in the intestinal region, and sending down the uro-genital secretions. (Susruta — *Nidānasthāna*, Chapter I.)

In the mediæval physiology the number of *Vāyus* is given as 49. As in Charaka and Suśruta, the *Vāyus* are regarded as the moving or impelling forces that work the organism and all its automatic and reflex machinery. The *Ajnā-vahā Nādis* (efferent nerves) are only channels for the conduction of commands of the self or the will (आत्मप्रयत्न); the *Vāyus*, on the other hand, are forces (or currents) that maintain the automatic, reflex or instinctive activities of the organism. The ten chief *Vāyus* with their functions are enumerated thus :—

(1) *Prāṇa*, which works the ideo-motor verbal mechanism and vocal apparatus, the respiratory system, the muscles engaged in coughing, sighing, etc.

(2) *Apāna*, which ejects the excretions and wastes, the urine, the fæces, the sperm and germ-cells, etc.

(3) *Vyāna*, whose work is extension, contraction and flexion of the muscles, tendons and ligaments ; the stored-up energy of the muscles.

(4) *Samāna*, the force, which, in conjunction with animal heat, works the machinery of metabolism, in the maintenance of the organic life. It drives or propels the chyle, blood, and every other current (*Śrota*) or circulating fluid in the body.

(5) *Udāna*, concerned in maintaining the erect posture of the body.

(6) *Nāga*, which is concerned in involuntary retching, vomiting.

(7) *Kurma*, which works the automatic movement of the eyelids, winking, etc.

(8) *Krikara*, concerned with the appetites of hunger and thirst.

(9) *Devadatta*, which brings about yawning, dozing, etc.

(10) *Dhanajaya*, which is concerned with coma, swooning, trance.

वायुः तन्त्रयन्त्रधरः प्रवर्तकः चेष्टानां, प्रणेता मनसः, सर्व्वेन्द्रियाणां उद्योतकः, सर्वशरीरधातु-व्यूहकरः, सन्धानकरः शरीरस्य, प्रवर्त्तको वाचः, हर्षोत्साहयोर्योनिः, क्षेप्ता बहिर्मलानां, कर्ता गर्भाकृतीनां। प्राणापानोदानसमानव्यानात्मा (चरक सूत्रस्थान Chapter XII) तेषां मुख्यतमः प्राणः शब्दोच्चारणनिःश्वासोच्छ्वासकाशादिकारणं, अपानः...अस्य मूत्रपुरीषादिविसर्गः कर्म्म कीर्त्तितं। व्यानः... प्राणापानधृतित्यागग्रहणाद्यस्य कर्म्म च। समानोऽपि अखिलं व्याप्य शरीरं वह्निना सह। द्विसप्तति सहस्रेषु नाडीरंध्रेषु संचरन् भुक्तपीतरसान् सम्यगानयन् देहपुष्टिकृत्। उदानः कर्म्मास्य देहोन्नयनोत्क्रमणादि प्रकीर्त्तितं। त्वगादिधातूनाश्रित्य पंचनागादयःस्थिताः उद्गारादि निमेषादि क्षुत्पिपासादिकं क्रमात्। तन्द्राप्रभृति मोहादि तेषां कर्म्म प्रकीर्त्तितं। (संगीतरत्नाकर)

Cf. the Summary in Raja Sourindra Mohan Tagore's edition of the Sangita Darpaṇa.

शब्दोच्चारणं (वाङ्निष्पत्तिकरणं) निश्वासः उच्छ्वासः (अन्तर्मुखश्वासः) तदादीनां कारणं (साधनं) प्राणवायुः। विण्मूत्रशुक्रादिवहत्वमपानस्य कर्म्म। आकुञ्चनप्रसारणादि व्यानस्य कर्म्म ज्ञेयं। अशितपीतादिनां समतानयनद्वारा शरीरस्य पोषणं समानस्य कर्म्म। उदानवायुः ऊर्द्ध्वनयनमेव अस्य कर्म्म नागादयः नागकूर्मकृकरदेवदत्तधनञ्जयरूपाः पञ्च वायवः। एतेषां कर्म्माणि च यथाक्रमं उद्गारोन्मीलनक्षुधाजननविजृम्भनमोहरूपाणि। (*Sangitadarpaṇa*, Chap. I, Ślokas 43-48). Cf. the extract in Sankara.

प्राणः प्रागवृत्तिरुच्छ्वासादिकर्म्मा । अपानः अवागवृत्तिरुत्सर्गादिकर्म्मा व्यानः तयोः सन्धौ वर्तमानः वीर्य्यवत्कर्म्महेतुः। उदानः ऊर्द्ध्ववृत्तिः उत्क्रान्त्यादि हेतुः । समानः समं सर्व्वेषु अङ्गेषु यः अन्नरसान् नयति । इति । (*Sâriraka Bhâṣya*, Chap. II, Pada 4, Sutra 2.)

SECTION 8.

FŒTAL DEVELOPMENT (AFTER SUSRUTA). *

The ovum fertilised by the sperm-cell and developing under the influence of animal-heat forms successive layers and tissues, even as layers of cells and fibres are formed in wood. First are formed seven layers, epithelial and dermal (*Saptatvacha*), then follow the several tissues (*Kalâh*), the flesh, the vascular tissue, the fat and marrow, the lymphatic and (glandular) tissue, the intestinal tissues, the biliary and the seminal vessels. These tissues are regarded by some as modifications of the original dermal layers of the ovum (cf. the layers of the blasto-derm and their relation to the tissues in Embryology). The tissues are supposed to be developed successively, one out of another, by chemical action or metabolism (*pâko*), *e.g.*, chyle is transformed into blood, blood into flesh, flesh into fat, fat into bone, bone (in reality, fat in the bones) into marrow, marrow into sperm-cell. The organs are next formed out of the tissues. The liver, gall-bladder (*kloma*), spleen and lungs are referred to the blood; the intestines to the blood, lymph and bile; the kidneys to the blood and fat; the testicles to the blood, lymph and fat; the heart to the blood and lymph; and the tongue to the lymph, blood and flesh. *Vâyu*, with the accompaniment of animal heat, impels the 'currents' (*srotâmsi*) in the system: *Vâyu* acting on the flesh gives rise to the muscles; and it is *Vâyu*, again, which, with the essence of fat (or marrow), produces the nerves, arteries and tendons (Susruta, *Sarîrasthâna*, Chapter IV, and *Sutrasthâna*, Chapter XIV).

The following parts (tissues and organs) in the fœtus are in a special sense modifications of the four organic substances (compounds) contributed by the sperm-cell of the male-parent, hair, nails, teeth, bones, nerves, veins, and arteries, tendons and ligaments, and the sperm-cell; the following of the four organic substances are derived from the mother: skin, blood, flesh, fat, the heart, liver and spleen, kidneys, stomach, intestines, &c. (Charaka, *Sarîrasthâna*, Chapter III).

The rudiments of the head and the limbs begin to appear in the third month, and are developed in the fourth; the bones, ligaments, nails, hair, &c. become distinct in the sixth. In the second month the sexual character is indicated by the shape of the fœtus, the shape of a round joint (?) indicating the male sex, and an elongated shape as of a muscle (?) the female sex [cf. Charaka, *Sârirasthâna*, Chapter IV,—द्वितीयेमासि घनः सम्पद्यते पिण्डः पेश्यर्बुदं या । तत्र घनः पिण्डः पुरुषः स्त्री पेशी अर्ब्बुद नपुंसकः Chakrapâni notes घनः कठिनः । पिण्डो ग्रन्थ्याकारः । पेशी दीर्घमांसपेश्याकारा । अर्बुद वर्तुलोन्नत loc cit.

SECTION 9.

HEREDITY.

Transmission of specific characters—what parental characters are transmitted to offspring. The question is raised in Charaka (and earlier still, in the *Brâhmanas*) how specific characters are transmitted,—why the offspring is of the same species as the parental organism, say, the human or bovine species, the equine species (Charaka), or the Asvattha species, Ficus religiosa, (Sankara Brihadâranyaka-bhâṣya). Species (योनयः) may be compared to so many moulds as it were, into which the ovum is cast, even as molten metals are cast in moulds. This is of course only an illustrative analogy; the cause has to be investigated.

* Reproduced from my monograph in Dr. Ray's *Hindu Chemistry*, Vol. II.

Now Charaka and Susruta, following Dhanvantari, hold that the fœtus, or rather the fertilised ovum, develops by palingenesis (instead of epigenesis) ; in other words, all the organs are potentially present therein at the same time and unfold in a certain order. As the sprouting bamboo-seed contains in miniature the entire structure of the bamboo, as the mango blossom contains the stone, the pulp, the fibres, which appear separated and distinct in the ripe fruit, though from their excessive minuteness they are undistinguishable in the blossom, even such is the case with the fertilised ovum.

गर्भस्य हि सम्भवतः...सर्व्वाङ्गप्रत्यङ्गानि युगपत् सम्भवति इत्याह धन्वन्तरिः । गर्भस्य सूक्ष्मत्वात् नोपलभ्यन्ते वंशाङ्कुरवत् चूतफलवच्च तद्यथा चूतफले परिपक्वे केशरमांसास्थिमज्जानः पृथक् दृश्यन्ते कालप्रकर्षात् । तान्येव तरुणे नोपलभ्यन्ते सूक्ष्मत्वात् । तेषां केशरादीनां कालः प्रव्यक्ततां करोति एतेनैव वंशाङ्कुरोऽपि व्याख्यातः । एवं गर्भस्य तारुण्ये सर्व्वेषु अङ्गप्रत्यङ्गेषु सत्सु सौक्ष्म्यादनुपलब्धिः तान्येव फलप्रकर्षात् प्रव्यक्तानि भवन्ति । (Susruta, *Sârîrasthâna*, Chap. III).

The inheritance of specific characters is explained in accordance with this view. Charaka assumes that the sperm-cell of the male parent contains minute elements derived from each of its organs and tissues. (Cf. Darwin's gemmule and Spencer's 'ids'). Sankara similarly states that the sperm-cell (or the seed in the case of a plant) represents in miniature every organ of the parent organism, and contains *in potentia* the whole organism that is developed out of it. (शरीरस्थात्वात्मा शुक्रभूतः अङ्गादङ्गात् सम्भवति । Charaka Sârîrasthâna, Chapter IV, cf. Sankara on Brihadâranyaka.)

But if this is so, why are not congenital deformities of the parent, or constitutional diseases contracted in later life, invariably inherited ? Congenital blindness, deafness, dumbness, stammering, lameness, or deformity of the spinal column or of the bony framework, or dwarfish stature, or constitutional diseases like madness, leprosy, or skin diseases in the parent, do not necessarily produce corresponding deformities or infirmities in the offspring. It cannot therefore be that the fertilised ovum represents in miniature every organ and tissue of the parental organisms. The solution of this difficulty Charaka ascribes to Âtreya. The fertilised ovum, it is true, is composed of elements which arise from the whole parental organism (समुदायात्मक, समुदायप्रभव), but it is not the developed organs of the parents, with their idiosyncracies or acquired characters, that determine or contribute the elements of the sperm-cell (or seed). The parental Vija (seed, germ-plasm) contains the whole parental organism in miniature (or *in potentia*), but it is independent of the parents' developed organs, and is not necessarily affected by their idiosyncracies or deformities. In fact, the parental Vija (seed, germ-plasm) is an organic whole independent of the developed parental body and its organs. In the parental Vija, an element representing a particular organ or tissue may happen (for this is accidental, दैव) to be defective or undeveloped, or otherwise abnormally characterised, and in this case the corresponding organ or tissue of the offspring will be similarly characterised. When constitutional diseases, acquired in later life, are found to be inherited, Âtreya would suppose that the Vija of the parent has been affected, and this would explain the fact of the inheritance. In the case of leprosy, for example, it is transmitted to the offspring, only when the germ-plasm (the Vija or the fertilised ovum) is infected with the virus of the disease by reason of the leprosy of the parent (*vide* Charaka's report of Âtreya's theory, Sârîrasthâna).

एवमयं नानाविधानां एषां गर्भकराणां भावानां समुदायादभिनिवर्त्तते गर्भः । यद्ययमेषां नानाविधानां गर्भकराणां भावानां समुदयादभिनिवर्त्तते गर्भः कथमयं सन्धीयते । यदि चापि सन्धीयते कस्मात् समुदायप्रभवः सन् गर्भो मनुष्यविग्रहेण जायते मनुष्यश्च मनुष्यप्रभवः उच्यते । ....तत्र चेत् इष्टमेतत्यस्मात् मनुष्यमनुष्यप्रभवः तस्मादेव मनुष्यविग्रहेण जायते यथा

गौर्गोप्रभवः यथा चाश्वः अश्वप्रभवः इत्येवं। यदुक्तं अग्रे समुदायात्मक इति तदयुक्तं । यदि च मनुष्यः मनुष्यप्रभवः कस्मात् जडान्धकुब्जमूकवामनमिन्मिनव्यङ्गोन्मत्तकुष्ठकिलासेभ्यो जाताः पितृसदृशा न भवन्ति et seq...

यच्चोक्तं यदि च मनुष्यो मनुष्यप्रभवः कस्मान्न जडादिभ्यो जाताः पितृसदृशरूपा न भवन्तीति तत्रोच्यते यस्य यस्याहि अङ्गावयवस्य बीजे बीजभाव उपतप्तो भवति तस्य तस्य अङ्गावयवस्य विकृतिः उपजायते। नोपजायते च अनुपतापात् तस्मात् उभयोपपत्तिरप्यत्र । सर्वस्य च आत्मजानीन्द्रियाणि तेषां भावाभावहेतुर्दैवं । तस्मान्नैकान्ततो जड़ादिभ्यो जाताः पितृसदृशरूपा भवन्ति । (चरक शारीरस्थान तृतीयपरिच्छेद) दम्पत्योः कुष्ठबाहुल्याद् दुष्टशोणितशुक्रयोः । यदपत्यंतयोर्जातं ज्ञेयं तदपि कुष्ठितं ।

N. B.—The seventh tissue (the *Sukradhara* kalá, sperm-bearing or reproductive) contains the parental Vija, which is a minute organism (समुदायात्मक) deriving its elements from the parental organs, but distinct from the latter, and independent of their peculiarities, and it is the combination and characters of these constituent elements of the parental Vija in the reproductive tissue, that determine the physiological characters and predispositions of the offspring. We may call this Âtreya's *germ-plasm theory*, for it is an advance on the conception of gemmules and of ids, but in Âtreya's version, the germ-plasm is not only representative of the somatic tissues, but also generates and is generated by the latter. This mutual interaction of the 'germ-plasm' and 'somatic tissues' is a distinctive feature of Âtreya's hypothesis, the value of which will be differently estimated by different schools of biologists.

I may also add that the continued identity of the germ-plasm (बीज) from generation to generation, though it follows as a corollary from this doctrine of a distinct reproductive tissue, even when conceived to be affected by somatic processes, as Âtreya and Charaka conceive it to be, is nowhere expressly deduced. On the other hand, Âtreya and Charaka emphasise the influence of abundant or defective nutrition, and of the (chemical) constitution of the food, etc., on the characters of the Vija in the reproductive tissue, especially as regards the sexual character, the stature, and the colour pigment (वर्ण) of the offspring. But though the influence of nutrition on the Vija is thus freely admitted in a general way, it is expressly stated that the peculiar characters or idiosyncrasies of the elements that combine to form the Vija must be regarded as a matter of chance (दैव), in other words, the truly congenital variations are accidental.

SECTION 10.

THE SEX QUESTION.

Influence of nutrition on the ovum especially as regards the sex, stature and colour-pigment of the resulting offspring;—In a general way, ghee and milk for the male, and oil and beans for the female parent, are favourable to the Vija. The sexual character of the offspring depends in part on a periodicity to which the life-history of the ovum in the female parent is conceived to be subject—a law of alternate rhythmic change (not unlike what we now know to regulate the development of several orders of bacteria or unicellular organisms), a law, under which the fertilisation of the ovum on the fourth day after the menstrual discharge, or on the alternate days succeeding, is favourable to the fœtus developing the male sexual character, and on the fifth, seventh, and alternate following days, to the fœtus assuming the female sex. The *Prayoga chintámani* states that the latter occurs on even days, and the former on odd days. Another factor is the relative predominance of the sperm and the germ-cells in the fertilised ovum. Excess of the sperm-cell produces the male, that of the germ-cell the female. For male offspring of tall stature, fair complexion and energetic temperament, wheat pulp with

honey, ghee (clarified butter), and milk should be taken by the female parent. Generally speaking, the adoption of the food, clothing, habits, of people of any particular clime are supposed to be favourable to the production of their characteristic stature and complexion. As to sex, the fœtus for a time remains indeterminate, and then takes on a definite male or female character, but before this stage is reached, the development of the sex can be modified to some extent by food and drugs (पुंसवनमौषधं). As for the colour-pigment, it is the animal heat (तेजोधातु) which is its source; but where the *Ākāśa* and *Ap*-particles predominate (in the food), the animal heat (of the metabolic processes) produces a fair complexion; where earth and Vāyu particles predominate in the food, blackness is the result, and where the different *bhutas* are combined in nearly equal proportion in the food, the metabolic heat produces a dark pigment. In the later literature, ghee (clarified butter) habitually taken by the female during gestation is supposed to produce a fair complexion; and rice (or wheat) and salads, a dark complexion. Charaka also holds that mental impressions of the parent are powerful factors in the determination of the characters of the offspring.

यथाहि बीजमनुपतप्तं उप्तं स्वां स्वां प्रकृतिं अनुविधीयते ब्रीहिर्वा ब्रीहित्वं यवोवायवत्वं तथा स्त्रीपुरुषौ अपि यथोक्तं हेतुविभागं अनुविधीयते ।......तस्मादापन्नगर्भां स्त्रियमभिसमीक्ष्य प्राग् व्यक्तीभावात् गर्भस्य पुंसवनमौषधमस्यै दद्यात् ।...स्नानात् प्रभृति युग्मेषु अहःसु संगमेतां पुत्रकामौ तौ अयुग्मेषु दुहितृकामौ ।...उपाचरेच्च मधुरौषधसंस्कृताभ्यां घृतक्षीराभ्यां पुरुषं स्त्रियन्तु तैलमाषाभ्यां । सा चेत् एवमाशासीत बृहन्तमवदातं-हर्य्यक्षं ओजस्विनं शुचिं सत्त्वसम्पन्नं पुत्र मिच्छेयमिति । शुद्धस्नानात् प्रभृति अस्यै मधुसर्पिर्भ्यां संसृज्य श्वेतायाः गोः स्वरूपवत्सायाः पयसा आलभ्य राजते कांस्ये वा पात्रे काले काले सप्ताहं सततं प्रयच्छेत् पानाय ।......या येषां जनपदानां मनुष्यानां अनुरूपं पुत्रमाशासीत सा तेषां जनपदानां मनुष्याणां आहारविहारोपचारपरिच्छदान् अनुविधीयस्व इति वाच्या स्यात् ।

न खलु केवलमेतदेव कर्म्म वर्णाणां वैशेष्यकरं अपितु तेजोधातुरपि उदकान्तरीक्षा धातुः प्रायः अवदातवर्णकरो भवति । पृथिवीवायुधातुः प्रायः कृष्णवर्णकरः । समसर्वधातुः प्रायः । श्यामवर्णकरः । आधिक्ये रेतसः पुत्रः। कन्यास्यात् आर्त्तवेऽधिरके' ।

SECTION 11.

LIFE.

The question of the vital force or vital principle :—

These activities maintain the life of the organism, but what is this life itself?

The *Chārvākas* (materialists and sensationalists) answer that life (as well as consciousness) is a result of peculiar chemical combinations of dead matter (or the four elements) in organic forms, even as the intoxicating property of spirituous liquors results from the fermentation of unintoxicating rice and molasses. Similarly, the instinctive movements and expressions of new-born babes (sucking, joy, grief, fear, etc.) can be explained mechanically as due to external stimuli as much as the opening and closing of the lotus and other flowers at different hours of the day (or night), or the movement of iron under the influence of the loadstone. In the same way, the spontaneous generation of living organisms is frequently observed, *e.g.*, the case of animalcules which develop in moisture or infusions, especially under the influence of gentle warmth (स्वेदज, उष्मज, दंशमशकादयः), or of the maggots or other worms which, in the rainy season, by reason of the atmospheric moisture, are developed in the constituent particles of curds and the like, which begin to live and move in so short a time.

(Gotama, in his *Sutras*, reports the Chârvâka explanation of instinctive emotional expressions in babes :—पद्मादिषु प्रबोधसम्मीलनवत् तद्विकार: Sutra 20, Ahnika 1, Chapter III, cf. the explanation of the movement preparatory to sucking ;—अयसो ह्ययस्कान्ताभिगमनवत् तदुपसर्पणं Sutra 23, *ibid.* Jayanta, in the *Nyâya-manjari*, reports the Chârvâka explanation of consciousness (and life).

मदशक्तिवत् विज्ञानं । पृथिव्यादीनि भूतानि चत्वारि तत्त्वानि । तेभ्य एव देहाकारपरिणतेभ्यः मदशक्तिवत् चैतन्यमुपजायते ।

For spontaneous generation, *vide* Jayanta's report.

वर्षासु च स्वेदादिना अनतिदवीयसैव कालेन दध्याद्यवयवा एव चलन्तः पूतनादिक्रिमिरूपा उपलभ्यन्ते

(*Nyâya-manjari*, Ahnika 7, भूतचैतन्यपक्षः)

The Sânkhya view of consciousness—Reply to the materialists—

The intoxicating power in liquor is a force, *i.e.*, a tendency to motion, and this is the resultant of the tendencies (or subtile motions) present in the particles of the fermented rice, molasses, etc. A motion, or a tendency to motion, can in this way be the resultant of several other motions or tendencies. But consciousness (चैतन्य) is not a motion, and cannot be the resultant of (unconscious) natural forces or motions. Neither can the consciousness of the Self, or of the organism as a whole, be supposed to be the resultant of innumerable consciousnesses vested in the innumerable constituent particles of the body. One central abiding intelligence is a simpler and therefore more legitimate hypothesis than an assemblage of consciousnesses latent in different Bhutas or particles, cf. Vijnânabhiksu's comment on the Sutra. मदशक्तिवच्चेत् प्रत्येकपरिदृष्टे सांहत्ये तदुद्भवः (Sutra 22, Chapter III.) ननु यथा मादकताशक्तिः प्रत्येकद्रव्यावृत्तिरपि मिलितद्रव्ये वर्त्तते एवं चैतन्यमपि स्यादिति चेन्न प्रत्येकपरिदृष्टे सति सांहत्ये तदुद्भवः सम्भवेत् । प्रकृते तु प्रत्येकपरिदृष्टत्वं नास्ति...ननु समुच्चिते चैतन्यदर्शनेन प्रत्येकभूते सूक्ष्मचैतन्यशक्तिरनुमेया इति चेन्न । अनेकभूतेषु अनेकचैतन्यशक्तिकल्पनायां गौरवेण लाघवादेकस्यैव नित्यचित्स्वरूपस्य कल्पनौचित्यात् । Cf. also भूतगतविशेषगुणानां सजातीयकारणगुणजन्यतया कारणे चैतन्यं विना देहे चैतन्यासम्भवात् । *ibid.*

मद्ये मदशक्तिर्न गुणः । मद्यारम्भकानां पिष्टगुडमध्व* दीनां यत् यस्य कर्म तैः कर्मभिरारब्धं स्वस्वकर्मविरोध कर्म्म यदुच्यते प्रभाव इति । चैतन्यादिकं न कर्म्म ।

(Vijnânabhikṣu—*Pravachanabhâshya*, Sutra, 22 Chapter III).

Cf. also Gangâdhara's *Jalpakalpataru*, (1867, Calcutta)—explaining the distinction between property (गुण) and power (प्रभाव), a technical term in medicine, which is a form of motion (कर्म्म) *Sutrasthâna*, Jalpakalpataru.

The Sânkhya view of Prâṇa (life) :—

Life, according to the Sânkhya, is not a *Vâyu* (biomechanical force) nor any mere mechanical motion resulting from the impulsion of Vâyu. The five vital operations, Prâṇa, Apâna, etc., are called *vâyus*, but this is only a metaphor. Life is in reality a reflex activity, a resultant of the various *concurrent* activities of the *Antaḥkaraṇas*, *i.e.*, of the sensori-motor (ज्ञानेन्द्रिय कर्मेन्द्रिय), the emotional (मनः) and the apperceptive reactions of the organism (for some add अहङ्कार)

Vijnânabhikṣu notes that this explains the disturbing (elevating or depressing) effect, on the vitality, of pleasurable or painful emotions like love (काम), which are activities of *Manas*, one of the *Antaḥkaraṇas* concerned in the reactions of the living organism. On the Sânkhya view, then, *Prâṇa* or life is not a Vâyu, nor is it evolved from the Bhutas, inorganic matter. Prâṇa is only a complex reflex activity (सम्भयेका वृत्ति) resulting from the operations of the psycho-physical principles or forces in the organism. (*cf.* **Sankara**

reporting the Sânkhya view—करणानि नियतवृत्तयः सन्तः सम्भूयैकां प्राणाख्यां वृत्तिं प्रतिपद्यन्ते । *Śârîraka-bhâṣya*, Chapter II, Pada 4, Sûtra 9) सामान्यकरणवृत्तिः प्राणाद्या वायवः पञ्च । (Isvarakrisṇa, Kârikâ).

Also Sûtra 31, Chapter II, where Vijnânabhikṣu notes :—

वायुवत् सञ्चारात् वायवः प्रसिद्धाः । अस्माकं नायं नियमः यदिन्द्रियवृत्तिः क्रमेणैव भवति नैकदा । जातिसाङ्कर्यस्य अस्माकं अदोषत्वात् । सामग्रीसमवधाने सति अनेकैरपीन्द्रियैः एकदैकवृत्त्युत्पादने बाधकं नास्ति । Vijnânabhikṣu, *Pravachana-bhâṣya*, Chapter II, Sutras, 31, 32. मनोधर्म्मस्य कामादेः प्राणक्षोभतया सामानाधिकरण्येनैव औचित्यात् । *ibid.*

The Vedântic view of Prâṇa.

The Vedântists are believers in an independent vital principle. They agree with the Sânkhyas in holding that *Prâṇa* is neither a *Vâyu*, nor the operation of a Vâyu. But neither is Life a mere reflex or resultant of concurrent sensori-motor, emotive and apperceptive reactions of the organism. You may put eleven birds in a cage, and if they concurrently and continually strike against the bars of the cage in the same direction, the cage may move on under this conjoint action. But the sensory and motor activities cannot in this way originate the vital activity of the organism. For the deprivation of anyone or more of the senses does not mean a deprivation of life, and above all there is this radical distinction: there is sameness of kind (समतीयत्व) between the motions of the individual birds and the resultant motion of the cage, but the sensations do not explain life. *Life* (Prâṇa) must therefore be recognised as a separate principle, just as the *Manas* and the *Antahkaranas* generally are in the Sânkhya Philosophy. Life is a sort of subtle rarefied 'other-principle' (अध्यात्मवायु) pervasive of the organism,—which is not gross Vâyu, but is all the same subtilised matter, like the Manas itself, for, in the Vedânta, everything other than the Self (आत्म) is "material" (जड़)

This Life is prior to the senses, for it regulates the development of the fertilised ovum which would putrefy if it were not living, and the senses with their apparatus develop subsequently out of the ovum (न वायुक्रिये पृथगुपदेशात्) Chapter II, Pada 4, Sutra 9, *vide* Sarîraka Bhâṣya Sankara,—also, Vâchaspati Misra, Bhâmatî :—

सिद्धान्तस्तु न सामान्येन्द्रियवृत्तिः प्राणः । स हि मिलितानां वा वृत्तिर्भवेत् प्रत्येकं वा । न तावत् मिलितानां । एकद्वित्रिचतुरिन्द्रियाभावे तदभावप्रसङ्गात् । नो खलु चूर्णहरिद्रासंयोगजन्माऽरुणगुणस्तयोरन्यतराभावे भवितु मर्हति । न च बहुविष्टिसाध्यं शिविकोद्वहनं द्वित्रिविष्टिसाध्यं भवति । न च त्वगेकसाध्यं । तथा सति सामान्यवृत्तित्वानुपपत्तेः । अपि च यत् सम्भूयकारकाणि निष्पादयन्ति तत् प्रधानव्यापारानुगुणावान्तरव्यापारेणैव । यथा वयसां प्रातिस्विको व्यापारः पिञ्जरचालनानुगुणः । इहतु श्रवणाद्यवान्तरव्यापारोपेतः प्राणा न सम्भूय प्राण्युरिति युक्तं प्रमाणाभावादत्यन्तविजातीयत्वाच्च श्रवणादिभ्यः प्राणनस्य । *** तस्मादन्यो वायुक्रियाभ्यां प्राणः । *** वायुरेवायमध्यात्ममापन्नः मुख्योऽपि प्राणः । Sankara, *ibid*. *Cf.* also, ज्येष्ठश्च प्राणः शुक्रनिषेककालादारभ्य तस्य वृत्तिलाभात् । नचेत् तस्य तदानीं वृत्तिलाभः स्यात् शुक्रं पूयेत न सम्भवेद्वा श्रोत्रादीनान्तु कर्णशष्कुल्यादिस्थानविभागनिष्पत्तौ वृत्तिलाभान्न ज्येष्ठत्वं । Sankara, on Sutra 9, Pada 4, Chapter II.

APPENDIX D.

HINDU IDEAS ON MECHANICS (KINETICS).

SECTION 1.

ANALYSIS OF MOTION.

In his Bhâṣya on the Vaiśeṣika Aphorisms written probably in the third or fourth century of the Christian era, if not earlier, Praśastapâda begins the Section on Motion (कर्म्म ग्रन्थ) with the definition of *karma* (motion, lit. work) as the unconditional cause of conjunction and disjunction, *i.e.*, of change of place in a particle (संयोग विभाग निरपेक्ष कारणं). He regards Karma (motion) as instantaneous (क्षणिक) in its simplest form, distinguishing it from *Vega* (impressed motion, momentum) which is a persistent tendency, Sanskâra, and implies a series of motions. Accordingly in one and the same particle, there can be only one motion (karma) at any given moment, since its change of place at that moment is one and definite (एकदा एकस्मिन् द्रव्ये एकमेव कर्म्म वर्त्तते। प्रशस्तपादभाष्य, कर्म्म पदार्थनिरूपणं). The supposition of two (instantaneous) motions in the same particle is superfluous. They may be so opposed as to neutralise each other, in which case the particle would be at rest. If they are not so opposed, and motion (*i.e.*, an instantaneous change of place) follows, then, since this change of place is a definite change, one motion would be sufficient to account for it, and the hypothesis of two motions would be meaningless (अथ अविरुद्धकर्म्मद्वयसमावेशः तदा एकत्वादेव उपपत्तेः द्वितीय कल्पनावैयर्थ्यम्—Prasastapâda). One and the same motion can affect only one particle, as the changes of place of different particles must be different (एकं कर्म्म न अनेकत्र वर्त्तते— *Ibid.*)

Now motion is always marked by a certain direction (दिग्विशिष्टकार्यारम्भकत्वस्य विशेषः):

(i) The successive motions of a particle may be in the same direction (rectilinear) *e.g.*, (*a*) upward or downward vertical motion, as in throwing upwards or downwards in the case of objects moved by volition directly or indirectly (उत्क्षेपणं, अपक्षेपणं), or (*b*) other forms of rectilinear motion, contraction, dilation (आकुञ्चनं, प्रसारणं) ;—

or (ii) the directions of the successive motions may be different as in curvilinear motion (यदनियत दिक्प्रदेश संयोगविभागकारणं तद्गमनं), *e.g.*, भ्रमण (rotatory motion), स्पन्दन (vibratory motion), etc. All these are varieties of Gamana (गमन, curvilinear motion) (उत्क्षेपणादिशब्दैः अनवरुद्धानां भ्रमणपतनस्पन्दनादीनां अवरोधार्थं गमनग्रहणं कृतम्.—*Ibid.*—cf. Sankara Misra, गमनत्वं च जातिविशेषः भ्रमणरेचनस्यन्दनोद्र्ध्वं ज्वलनन मनोगमनादिष्वपि). In another sense, all kinds of motion in material (inanimate) objects, whether rectilinear or curvilinear, are called Gamana (गमन).

(एतत् पञ्चविधमपि कर्म्म शरीरावयवेषु च तत् सम्बद्धेषु तत् मत्ययं असत् प्रत्ययं च। यत् अन्यत् अप्रत्ययमेव तेषु अन्येषु च तत् गमनमिति Praśastapâda, कर्म्मग्रन्थ)।

Single particles, then, may have a serial motion when particles (अवयवाः) combine to form a body (अवयवी), they may move continuously in a straight line, in which case the body is said to move in that direction (अवयविक्रियाया यावदवयवक्रिया नियतत्वात् the action of a composite whole is determined by the action of the constituent parts taken together). But different particles may move in different directions, or again, the particles may have a curvilinear motion, and in such cases it appears as if different motions are impressed on the body, *e.g.*, the falling leaf driven by the wind may have a rotatory or vibratory motion (भ्रमण, स्पन्दन) and a vertical downward motion (पतन) at the same time. Here each particle of the leaf taken separately has only one motion or change of place at the same moment, but from the point of view of the observer द्रष्टा, the particles

have a rotatory or vibratory motion in one relation, and the leaf as a whole has a downward motion in another relation. The motion at any instant is really one, but for convenience of analysis we consider the rotatory change of place as separate from the change of place in the downward direction, एकस्मिन् कर्म्मणि युगपत् द्रष्टॄणां भ्रमणपतनप्रवेशन प्रतयया कथं भवन्ति। अत्र युम अवयवावयविनो दिग्विशिष्टसंयोग विभागानां भेदात्—*Ibid.*

SECTION 2.

MOTION CONSIDERED IN RELATION TO ITS CAUSES.

Various kinds of motion are observed :—

I. Movements which are not caused by contact with matter :—

(1) Movements caused by volition (प्रयत्न) *e.g.*, the movement of the hand.

(2) Movement, as of a falling body. This is caused by gravity (गुरुत्व) which in the astronomical treatises of Âryabhata, Brahmagupta and Bhâskara, is ascribed to the attraction (आकर्षण, pulling force) exercised by the Earth on a material body. The force of gravity may be counteracted by volition (विधारक, प्रयत्न) as in holding of the hand, or by contact, as when a body rests on a support, or by *vega* (वेग), impressed motion, as in the flying arrow which is kept from falling by the motion impressed on it.

(3) Motion of fluids, as the downward flow in a stream (स्यन्दन). This is due to fluidity (द्रवत्व) which is a characteristic property of certain kinds of atoms, in some cases original, in others produced by the contact of these atoms with the atomic particles of heat (*e.g.*, in the fire). But Sankara Misra points out that this property, fluidity, is only a concomitant condition (असमवायिकारण), the efficient cause (निमित्तकारण) is even in this case gravity (गुरुत्व) in the particles of the fluid. यत्दूर संसरणंस्यन्दनं तत् द्रवत्वात् असमवायि कारणात् उत्पद्यते, गुरुत्वात् निमित्तकारणात् असमवायिकारणेषु. (Sankara Misra, Upaskâra, on Sutra 4, Ahinka 2, Chap. V, of the Vaiśeṣika Sutras).

(4) Certain motions, not due to material contact, of which the mechanical causes are unknown and which may be ascribed to the universal final cause, Adriṣta (अदृष्ट,) *e.g.*, the first motion in atoms at the beginning of creation, the upward motion of fiery particles or atoms, and the oblique motion of gaseous particles, *vâyu*, (वायु), the movement of iron towards the magnet, capillary motion (अभिसर्पण) as of liquid particles from the root to the stem of a plant. The upward motions (आरोहण) of water-particles in evaporation and in boiling do not require the hypothesis of Adriṣta, as these are caused by the pressure of heat corpuscles (तेज: परमाणु) and the contact with air particles (नोदनापीडनात् संयुक्तसंयोगाच्च—Vaiśeṣika Sutra, Chap. V, Ahnika 2).

MEANING OF ADRIṢTA (अदृष्ट)

Adriṣta (lit. unseen) stands for 'unknown cause' or 'unexplained Nature' in the earlier Vaiśeṣika writers. Several classes of cases falling under Adriṣta are distinguished, *e.g.*

(1) the operation of merit and demerit (धर्म्म) and (अधर्म्म), a transcendental cause, which has to be posited in explaining the conjunctions and disjunctions of souls with their organic vehicles (bodies), which cannot be ascribed to natural causes, but presuppose the law of karma, or the operation of moral causation, as super-imposed on the natural order,

(2) various kinds of motion, in the different classes of elements, *e.g.*, their natural modes of operation, such as the dispersion of Vâyu (air, gas), the upward motion of fire, the attraction of the needle by the magnet, etc., motions which serve the ends

of Creation and of created beings (उपकारकं अपकारकं). Such natural properties must be ascribed to Adrista, final causality (उपकारापकारसमर्थं अदृष्टकारितं), provided the *cause cannot be ascertained by observation or inference.*

1. लब्धवृत्तिभ्याम् धर्म्माधर्म्माभ्याम् कर्म्मोत्पद्यते--*Ibid.* अपसर्पणकर्म्म उपसर्पणकर्म्म, etc.

2. एवमन्यदपि महाभूतेषु यत्प्रत्यक्षानुमानाभ्यामनुपलभ्यमानकारणं उपकारापकारसमर्थं च भवति तदपि अदृष्टकारितं—*Ibid.*

Jayanta in the Nyâya-Manjari notes that Adrista is resorted to in explanation of observed phenomena only when these cannot be derived in any way from the operation of known causes—यदि अदृष्टमन्तरेण दृष्टं न सिद्ध्यति काममदृष्टं कल्प्यताम् अन्यथा अपितु तदुपपत्ती किं तदुपकल्पनेन। दृष्टसिद्धयेहि अदृष्टं कल्प्यत्वे नतु दृष्टविघाताय। न्यायमञ्जरी—Ahnika I.

Similarly, Jayanta notes that, when anything is put down as natural (स्वाभाविक), we may mean either that it has no cause or no uniform cause, or no known cause. Of these, the first two alternatives must always be dismissed. And 'natural' can only mean something of which no cause has yet been ascertained (स्वाभाविकं नाम किमुच्यते किमहेतुकं अविज्ञातहेतुकं अनियतहेतुकं वा। न तावदहेतुकं कार्य्यं सम्भवति............नापि अनियतहेतुकं कार्य्यं किञ्चिदस्ति – न्यायमञ्जरी—चार्वाकमतनिरास।

This sound interpretation of Adrista was afterwards obscured. In modern writers of the Nyâya-Vaisesika School, physical and mechanical ideas have suffered a set-back, and even the formation of the hailstone is ascribed to the operation of moral causes (धर्म्माधर्म्म).

II. We come now to motions produced by contact (संयोग). Such motions may be classed as follows, according to the nature of the contact originating them :—

(1) Motion due to direct contact with a body exercising continued pressure (नोदन) *e.g.*, the motion of an object pushed or pulled by the hand, the motion of the mud under heavy stones, the motion of the arrow due to the pressure exercised by the bowstring, the motion of the bowstring due to the pressure of the elastic bow as it recovers its original shape, the motion of clouds, of volumes of dust, of balloons, sailing vessels, and other vehicles, under the impelling force (pressure, नोदन: प्रेरण) of the wind, etc. वायुमेघादिप्रेरणधारणादि समर्थः (Prasastapâda, वायुनिरूपण--मेघादीत्यादिपदेन यानपोतादिपरिग्रहस्तेषामपि वायुना प्रेर्य्यमाणत्वात्। Sridhara मेघादीति आदिग्रहणात् वैहायसानां विमानादीनां (balloons in the sky) भौमादीनां च पानपात्रपांशुपटलादीनां जलानलयोश्च परिग्रहः (Udayana, Kiraṇâvalî, वायुनिरूपणम्)

N.B. Udayana makes a similar reference to balloons filled with gas or smoke (धूमापूरित-चर्म्मपुटकं) in discussing the opinion that air has weight (Kiraṇâvalî, वायुनिरूपणम्) These passages show that balloons were known in Udayana's time (974 A. D.—*vide* उदयन, Lakṣaṇâvali).

(2) Motion due to direct contact for an instant with a body that strikes and produces an impact (अभिघात) *e.g.*, in the cases of a stone falling against a hard object (पाषाणादिषु निष्ठुरेःवस्तुनि अभिपतितेषु--Sridhara), the potter's rod striking the wheel, the mortar struck against the pestle. Instantaneous disjunction is necessary to impact. If there is continued contact, the result is pressure (नोदन,). In some cases there may be disjunction (*i.e.*, a rebound) after continued pressure (यत्र अभिघातके द्रव्यं भूमदेशं अभिहत्यं किञ्चिद्दूरं नीत्वा उत्पतति-श्रीधर—न्यायकन्दली).

(3) Motion due to direct contact with an elastic body which exercises a moving force by means of its elasticity (स्थितिस्थापकत्व) in the act of restitution of the original form, (यथा स्थितं स्थापयति) *e g.*, the motion of the bow-string due to the force exercised by the piece of bamboo (the bent bow). This force of restitution in an elastic body is a kind of sanskâra,

i.e., persistent tendency (धनुशाखाशृङ्गदन्तास्थि सूत्रवस्त्रादिषु भुग्नसम्यत्तिंतेषु स्थितिस्थापकत्वकार्य्यं संलक्ष्यते —प्रशस्तपादभाष्य bows, twigs, tooth-bones, horn, thread, cloth, etc., are noted as elastic).

(4) Motion due to contact with a body which is itself in contact with another which possesses Vega (impressed motion or momentum). (वेगवद्द्रव्यसंयुक्तसंयोग) This is the fact of the transmission of pressure or moving force, and the consequent production or communication of motion, as for example, in the pulling of an object by means of a string, the pushing of the potter's wheel by the potter's rod, etc.

SECTION 3.

CAUSE OF MOTION, OR FORCE.

Force is of the following kinds :—

1. Continued pressure (नोदन)
2. Impact (अभिघात).
3. Persistent tendency (संस्कार) of which there are two kinds—(*a*) Vega (वेग impressed motion, momentum), the persistent tendency to motion in a moving body, and (*b*) the tendency to restitution of shape in an elastic body (स्थितिस्थापकसंस्कार).

   N. B.—The metaphysical *sanskára* (भावना) is here omitted.

4. Transmitted force, as in pulling by a string, pushing by a rod, etc.
5. Gravity.
6. Fluidity.
7. Volition.
8. Adrista, comprising various unknown agencies.

In every case of motion produced by contact, Vega is a contributary cause, as the body originating the motion must possess Vega (impressed motion, momentum).

The concept of Vega (वेगाख्य संस्कार).

A motion (karma) being conceived as a change of place in a particle is held to be incapable of producing another motion; but the pressure, impact or other force which produces the first motion produces through that motion a *sanskára* or persistent tendency to motion (*vega*), which is the cause of continued motion in a straight line, *i.e.*, in the direction of the first motion (नियतदिक् क्रिया प्रबन्धहेतुः यत् दिगाभिमुख्येन क्रियावेगो जन्यते तत् दिगभिमुखतेयैव क्रिया सन्तानस्य हेतुरिति—श्रीधर, न्याय-कन्दली संस्कारनिरूपणम्)

The Vaiśeṣikas accept one *sanskára* (impressed motion, momentum) lasting till the cessation of the motion. Udyotakâra and other writers of the Nyâya School suppose a series of *sanskáras*, each generating the one that succeeds it. (संस्कारेण उत्तरोत्तरकर्म्मसन्तानो जायते स्वजन्योत्तरसंयोगेन कर्म्मणि नष्टे संस्कारेण कर्म्मान्तरजननात् एक एव संस्कारः कर्म्मसन्तानजनकः नतु कर्म्मसन्तानवत् संस्कार-सन्तानोऽपि अभ्युपगन्तुमुचितः— शङ्करमिश्र). It will be seen that the Nyâya view is adequate to explain acceleration which it logically implies. The force of *sanskára* (शक्ति) diminishes by doing work (कार्य्यकरणात्) against a counteracting force, and when the *sanskára* is in this way entirely destroyed, the moving body comes to rest (संस्कारो यावत्–पतनमनुवर्त्तते । यथा यथा चास्य कार्य्यकरणात् शक्तिः क्षीयते तथा तथा कार्य्यमन्दतरतमादिभेदभिन्नमुपजायते —श्रीधर–न्याय-कन्दली–कर्म्मग्रन्थ)-Vega, it will be seen, corresponds to inertia in some respects, and to momentum (impressed motion) in others. This is the nearest approach to Newton's First Law of Motion in the Vaiśeṣika theory of motion.

Vega (impressed motion), or this tendency to move on in a straight line, is counteracted by contact with tangible objects (स्पर्शवद्द्रव्यसंयोग), *e.g.*, by impact or friction (including friction with the still atmosphere (स्तिमितवायु), as in the case of the arrow).

Vega (momentum) produces work in opposition to the resisting force, and thereby becomes weaker and weaker (मन्दतर मन्दतम) until it comes to an end. (तत्र वेगो मूर्त्तिमत्सु पञ्चसु द्रव्येषु निमित्तविशेषापेक्षात् कर्म्मणा जायते, नियत-दिक्-क्रिया-प्रबन्धहेतुः स्पर्शवद्द्रव्यसंयोग-विशेषविरोधी Prasastapâda, संस्कार निरूपणम्—मन्दस्तु वेगः स्पर्शवद्द्रव्यसंयोगमात्रेण विनश्यति यथा अतिदूरगतस्य इषोः स्तिमितवायु-प्रतिबद्धस्य-श्रीधर, संस्कारनिरूपणम्)

Causes of Pressure (नोदन) *and of Impact* (अभिघात).

Pressure is produced by contact acting in conjunction with Vega (impressed motion), elasticity, gravity, fluidity or volition ; *e.g.*, the Vega of the wind produces pressure (नोदन) on the grass, that of a current of water on the reed, that of the bowstring on the arrow. Gravity with contact produces pressure, as when the earth sinks under a heavy load.

Impact is produced by contact with a body possessing Vega (impressed motion) where the contact is instantly followed by disjunction (or rebounding). If the contact continues, the result is pressure (नोदन) (तत्र नोदन गुरुत्व-द्रवत्व-वेग-प्रयत्नान् समस्त-व्यस्तान् अपेक्षमाणः यः संयोग-विशेषः नोदनं अविभाग-हेतुः एकस्य कर्म्मणः कारणं तस्मात् चतुर्षु अपि महाभूतेषु कर्म्म भवति.........वेगापेक्षो यः संयोग-विशेषः विभागहेतुः एकस्य कर्म्मणः कारणं स अभिघात तस्मादपि चतुर्षु-महाभूतेषु कर्म्म भवति—प्रशस्तपाद-भाष्य).

It is expressly noted that the four elements, earth, water, air and fire, are all subject to the forces of pressure and impact. Pressure and impact may be of different degrees (तीव्रमन्दादिभेद). So also *vega* (impressed motion, momentum.)

Illustrations of Combination of Forces.

(1) Pressure acting concurrently with impressed motion or *vega*, as when the moving hand possessing Vega throws the quoit or a projectile. (पाणिमुक्तेषु गमनविधि :) ततः संस्कारनोदनाभ्या तावत् कर्माणि भवन्ति यावत् हस्ततोमर-विभाग इति—प्रशस्तपादभाष्य.)

Similarly, in the case of the bowstring impelling the arrow, or the potter's wheel impelled by the rod, the first motion is due to pressure (नोदन), and results in a *sanskâra* (persistent tendency to motion, impressed motion or momentum), but the subsequent motions are produced by the pressure acting concurrently with the *sanskâra* (impressed motion) (तस्मात् संस्कारात् नोदन-सहायात् तावत् कर्म्माणि भवन्ति यावत् इषुज्या-विभागः —प्रशस्त-पाद, कर्म्मग्रन्थ—प्रथमं चक्रावयविनि दण्डसंयोगात् कर्म्म उत्पद्यते उत्तरोत्तराणि कर्म्माणि अभिघातात् कर्म्मजात् संस्कारात् च भवन्ति दण्डविगमे तु चक्रं तदवयवेषु च संस्कारादेव केवलात् । श्रीधर न्याय-कन्दली, कर्म्म ग्रन्थ)

(2) Impact (अभिघात) with impressed motion (संस्कार), as when the mortar thrown by the hand rebounds after striking the pestle (संस्कारापेक्षात् अभिघातात् मुसले उत्पतन-कर्म्म—प्रशस्तपाद भाष्य).

(3) Pressure (नोदन) acting concurrently with impact (अभिघात), as when the mud sinks when we strike against the ground with the feet. Here, if the feet be not in contact with the mud, but only with the surrounding ground, there is transmitted force (संयुक्त संयोग).

(पद्भ्यादिभिर्नुद्यमानायामभिहन्यमानायाम् वा पंकाख्यायां पृथिव्यां यत् संयोगोनोदनाभिघातयोरन्यतरापेक्षो उभयापेक्षो वा स संयुक्तसंयोगः तस्मादपि पृथिव्यादिषु कर्म्म भवति । Prasastapâda).

(4) Gravity concurrently with *sanskâra* or persistent tendency, as in the case of a falling body in the second and following instants. Also the case of a stone thrown against the mud, where gravity (the weight of the stone) combines with the Vega of the stone to produce motion in the mud (Prasastapâda). (आद्यं कर्म्म गुरुत्वात् भवति तेन कर्म्मणा संस्कारः क्रियते तदनन्तरं उत्तर-कर्म्माणि गुरुत्वसंस्काराभ्यां जायते द्वयोरपि प्रत्येकं अन्यत्र सामर्थ्यावधारणात्—श्रीधर, न्याय-कन्दली, कर्म्म ग्रन्थे सत्प्रत्यय-कर्म्मनिरूपणम्). This case will be further noticed below.

Udyotakâra, the commentator on the Nyâya-Bhâṣya, states that a heavier body falls to the ground with greater Vega (and velocity) than one that is lighter. Udyotakâra also holds, and Sridhara agrees with him, that the gravity (गुरुत्व) of a body (अवयवी) as a whole

composed of particles (अवयवा:) is not the same as the sum of the gravities of the particles. There is a difference in amount which is, however, so small as to be imperceptible. The concept of mass in the New Mechanics of Lorenz may lend some countenance to this curious metaphysical speculation. (Sridhara, गुणग्रन्थ, गुरुत्वनिरूपणम्).

(5) Volition acting concurrently with gravity, as in lifting the hand. This is accompanied by transmission when an object (*e.g.*, the quoit) is lifted by the hand.

Sanskâra (impressed motion, momentum) with or without pressure (नोदन) or impact (अभिघात) may be transmitted (दण्डसंयुक्तस्य अवयवस्य उत्तरोत्तरकर्म्माणि संस्कारात् नोदनाञ्च अपरेषां संस्कारात् संयुक्तसंयोगाच्च Sridhara).

Composition of Gravity with Vega (momentum).

When a body is let go and falls to the ground, the force acting on it is gravity (गुरुत्व) which the astronomers ascribe to the attraction of the Earth. Motion is produced in the first instance by gravity alone, and this leads to a *sanskâra* (impressed motion) in the same direction. But the force of gravity continues to operate, so that, in the moments following the first, the motion is due to gravity as well as *sanskâra*. The resultant motion is one, but both the causes must be conceived as contributing to the resultant. The reason for supposing this combined action is that both gravity and *sanskâra* (impressed motion or momentum) are seen elsewhere to produce motion separately.

In the case of the falling body, therefore, there is the composition of the two, gravity and vega, acting in the same direction (उभयसमावेश:) from the second instant onwards. It is as if two motions coalesced and resulted in one.

Here a good foundation is laid for the explanation of the accelerated motion of falling bodies, but Galileo's discovery was not anticipated, as Galileo's observations and measurements of motion were wanting (आद्यं कर्म्म गुरुत्वात् भवति तेन कर्म्मणा संस्कार: क्रियते तदनन्तरं उत्तरकर्म्माणि गुरुत्व-संस्काराभ्याम् जायन्ते द्वयोरपि प्रत्येकं अन्यत्र सामर्थ्यावधारणात्— श्रीधर, कर्म्मग्रंथ — तत् आद्यं गुरुत्वात् द्वितीयादीनि तु गुरुत्व-संस्काराभ्याम्, प्रशस्तपाद, कर्म्मग्रन्थ ।)

But in the case of the flying arrow or other projectile, the impulsive force which produces *vega* counteracts the force of gravity; in the end, this *vega* is lost through friction with air, and then gravity (गुरुत्व) brings the arrow to the ground. The meaning of this "counteraction" is not clear. Is it intended that the action of gravity is suspended as long as the *vega* continues? We have seen that, in the case of a body let fall, Praśastapâda expressly states that gravity (गुरुत्व) and *sanskâra* (*vega*, momentum) both act in the second and following instants. Praśastapâda seems to have thought that some *sanskâras* (*e.g.*, the *vega* of an arrow or other projectile) suspend the action of gravity (गुरुत्वं संयोग-प्रयत्न संस्कारविरोधि, Praśastapâda, गुणग्रन्थ । वेगेन प्रतिबन्धात् अपतनं यद्विच्छिन्नस्य शरशलाकादे: निवृत्ते नोदने कर्म्माणि उत्तरोत्तराणि इषु-संस्कारादेवापतनादिति Praśastapâda, Sridhara, कर्म्मग्रन्थ). Other *sanskâras* (*e.g.*, in the case of a falling body) coalesce with gravity to produce a single resultant motion. The later commentators (from Sridhara downwards) certainly interpret the Vaiśeṣika Sutras in this sense.

Motion of a particle in the case of a composition of forces.

Any number of motions or *vegas* may be impressed on a particle, but so long as these are in a uniform direction (नियतदिग्विशिष्ट) the resultant motion or *vega* is in a straight line and may be conceived as one. (द्वितीय कल्पना-व्यर्थम् Praśastapâda, कर्म्मग्रन्थ). It is only when we come to Gamana (curvilinear motion) and its causes that the question of composition assumes a real significance. In all such cases, each separate particle has only one Vega (impressed motion) in a definite direction (नियतदिगाभिमुख्य) at any given instant, but the

composition of the successive motions and Vegas in the same particle produces the curvilinear motion (गमन) *e.g.*, the rotation of each constituent particle of the potter's wheel. The motion of the body (अवयवी *e.g.*, the wheel) results from the combined motions of the particles (अवयवा:). If pressure or impact produces motion in an opposite direction to the Vega already impressed on the body, the original direction would be changed, as is seen in the case of rebounding (उत्पतन) after impact (अभिघात). The mortar rebounding after striking the pestle is a typical instance of such change of direction in Vega or motion. The impressed force, *e.g.*, impact (अभिघात), produces a changed motion in a different direction. One view is that the original Vega (momentum) is destroyed before a new motion and a new Vega are produced by the impact. Others hold that the impact does not destroy the original Vega (momentum), but conjointly with it produces the changed motion and, through such motion, a changed Vega in a new direction. (उलूखलमुसलयोरभिघातास्य: संयोगोमुसलगतवेगमपेक्षमाण: मुसले उत्पत्तेन कर्मकरोति यद्यपि प्राक्तनसंस्कारो विनष्ट: तथापि मुसलोलूखलयो: संयोग:पटुकर्म्मोत्पादक: तस्य संस्कारारम्भ साचिव्यसमर्थो भवति अथवा प्राक्तन एव पटु संस्कार: अभिघातात् अविनश्यन् अवस्थित इति *et seq.* Prasastapâda, कर्म्मग्रन्थ).

Typical cases of curvilinear motion (Gamana).

Vortical Motion :—This is due to the contact of two bodies moving in opposite directions with a like or equal Vega, *e.g.*, two currents of air or water meeting from opposite directions. The change of direction is seen in the fact that water which flows downwards, or air which moves obliquely, may receive an upward motion as the result of such collision. (अथ किमिदं संमूर्च्छनं नाम । समानजवयो: (तुल्यवेगयो:) वाय्वोर्विरुद्ध-दिक्क्रिययो: सन्निपात: Prasastapâda, वायुनिरूपणं). The Scholiast Udâyana adds : वाय्वोरितिप्रकृतत्वेन स्पर्शवतोरिति तु विवक्षितम् । अपां यथा द्रव्यान्तरसंमूर्च्छनात् ऊर्द्ध्वगमनं परस्पराभिहतनदीपय:—उदायन द्रव्यकिरणावली. Sridhara notes :—तिर्य्यग्गति स्वभाव-द्रव्योर्द्ध्वगतित्वात् परस्पराभिहत जलतरङ्गोर्द्ध्वं गमनवत् असमानवेगयो संमूर्च्छनं न भवति एकेन अपरस्य विजयात्—Sridhara).

Vibratory motion (कम्पन, स्पन्दन)

This will be analysed in the chapter on Acoustics.

Rotatory motion (भ्रमण).

Each particle of the rotating body, *e.g.*, the potter's wheel (चक्र), has, at any given instant, a motion in a definite direction. The rotatory motion of the body results from the separate motions of the particles, and their persistent tendencies (संस्कारा:), joined with the fact of the rigid conjunction of the particles. When the rod strikes one part of the wheel, the motion in the part struck is in the first instant produced by impact (अभिघात,); while the other parts move through the transmission of force due to the rigid cohesion of parts. The subsequent motions in the part struck are due to continued pressure (नोदन) and the persistent tendency (संस्कार) set up by the first motion; while the subsequent motions in the other parts are explained by their own persistent tendencies and the transmission due to rigid cohesion. When the rod is disjoined from the wheel, the rotatory motion continues, being due merely to the persistent tendencies in the constituent parts and the resultant persistent tendency in the whole.

Other varieties of curvilinear motion in bodies are to be similarly explained (*i e.*, by the composition of Vegas) (तथा चक्रादिषु अवयवानाम् पार्श्वत: प्रतिनियतदिग्देशसंयोगविभागोत्पत्तौ यदवयविन: संस्कारादनियतदिग्देशसंयोगविभागनिमित्तं कर्म्म-तद्भ्रमणमिति । एवमादयो गमनविशेषा:—Prasastapâda—कर्म्मग्रन्थ । एवं वेगात् दण्डसंयोगचक्रावयवे आद्यं कर्म्म दण्डसंयोगात् । अवयवान्तरेषु च संयुक्तसंयोगात् दण्डसंयुक्तस्य अवयवस्य उत्तरोत्तरकर्म्माणि संस्कारात् नोदनात् च । अपरेषां संस्कारात् संयुक्तसंयोगात् च दण्डविगमेतु चक्रे तदवयवेषु च संस्कारादेव केवलात् एवमादयो गमनविशेषा:—Sridhara).

SECTION 4.

MOTION OF FLUIDS.

Current motion (स्यन्दन, downward flow in a stream), upward motion (आरोहण, *e.g.*, evaporation, boiling, etc.), and capillary motion (अभिसर्पण, as in plants and porous vessels) are three varieties of fluid motion which require explanation. To this may be added vortical motion (संमूर्च्छन), and (स्यन्दन) wave motion which will be noticed in the chapter on Acoustics.

1. Current Motion स्यन्दन

This is conditioned by fluidity in particles, but Sankara Misra notes that in the downward flow of water, gravity in the fluid particles is the efficient cause (गुरुत्वात् निमित्त-कारणात् असमवायि-कारणेषु —Sankara Misra, उपस्कार). When the water is enclosed on all sides, as in a vessel, the downward flow (स्यन्दन) is counteracted. Here the fluidity does not produce motion, because, in the case of the particles in contact with the enclosing body, there is the resistance (प्रतिबन्ध) of the latter, which is transmitted to the other particles, and this counteracts the fluidity (स्रोतो भूतानामपां स्थलान्निम्नाभिसर्पणं यत् तत् द्रवत्वात् स्यन्दनं कथं समन्तात् रोधः संयोगेन अवयविद्रवत्वम् प्रतिबद्धं उत्तरोत्तरावयव-द्रवत्वानि संयुक्तसंयोगैः प्रतिबद्धानि—Praśastapâda, कर्म्म ग्रन्थ).

2. Upward Motion (आरोहण, *e.g.*, evaporation).

In evaporation, the fluid particles are rarefied, and remain in a fine state of suspension; the rarefaction is due to the impulse (नोदन) or impact (अभिघात) of the heat particles in the sun's rays, and the upward movement is due to their contact with the air under this impulse or impact. Sankara Misra notes that in boiling there is a similar upward movement of water particles under the impact of heat rays. (नाड्यो वायुसंयोगात् आरोहणं नोदनापीडनात् संयुक्तसंयोगात् च। Sutras 5 and 6, Ahnika 2, Chap 5, Vaisheshika Aphorism). (यथा स्थालीस्था आपः वक्ष्यमानाः वायुनावह्नि-रश्मय ऊर्ध्वम् नयन्ति —Sankara Misra, उपस्कार).

N.B.—These two Sutras of Kanâda have been interpreted by the late Gangâdhara Kaviratna in his commentary to refer to the upward conduction of water in pipes by the pressure of air.

The mention of the transmitted pressure (संयुक्तसंयोग) of the air seems to lend some countenance to Gangadhara's view, and the word Nadi (नाड्य) offers no difficulty, being taken in its usual sense pipe (नालिका, Nalikâ) while the current interpretation does violence to the common acceptation of the word.

3. Capillary Motion (अभिसर्पण)

Two instances are given,—the ascent of the sap in plants from the root to the stem, (अभितः सर्पणं मूले निषिक्तानामपां वृक्षे —Sankara Misra) and the penetrative diffusion of liquids in porous vessels, *e.g.*, of the oil or ghee in an earthen jar (कुम्भादौ अन्तर्निहितानां तैलघृतादीनां स्यन्दन अपनश्च). Heat particles have a like penetrative power (दृष्टश्चाविरोधो भर्ज्जनकपालादौ तेजसः पच्यमानद्रव्य पाकसिद्धेः. कलशे च निषिक्तानां अपां शीतस्पर्शग्रहणादविरोधः —Jayanta, न्यायमञ्जरी, Ahnika 8, इन्द्रियाणां प्राप्यकारित्वम्).

This is ascribed to *adrista*, as the cause cannot be ascertained by either perception or inference (including hypothesis) (प्रत्यक्षानुमानाभ्यां अनुपलभ्यमानकारणम् —Sridhara.)

SECTION 5.

INTERESTING EXAMPLES OF MOTION ASCRIBED TO ADRISTA (UNKNOWN CAUSE, UNEXPLAINED NATURE, FINAL CAUSE.)

The first motions in primordial atoms at the beginning of Creation are attributed to *Adrista*. Among movements in masses of matter so caused are noted the motion of the globe of the earth and similar other bodies (महाभूतानां भूगोलकादीनां प्रभवेन चलनम् Praśastapâda

with Sridhara's commentary, कर्मग्रन्थ). Most probably this means earthquakes, tides, etc. Aryabhata and his school would no doubt bring under this head the diurnal motion of the earth. It is interesting to note in this connection that Bhâskara refutes the Buddhist hyphothesis of the earth falling perpetually *in vacuo*, by arguing that the earth must remain balanced in space, as there is nothing outside to attract it.

The movement of the needle (iron in general, as Sankara Misra notes) towards the magnet is another example of unexplained motion in matter. Cleaning and right placing of the magnet (संमार्जनम्, ऋजुस्थापनम्) are necessary सूचीनां लोहशलाकानां, अयस्कांताभिमुखगमनम्, सूच्यत्युपलक्षणम् अयस्कान्ताकृष्टलोहमात्रमभिमेतम् —Sankara Misra.

Similarly amber attracts grass (straw, etc.)

(तृणकान्तमन्याकृष्टानां तृणानां गमने Sankara Misra, on Sutra 15, Ahnika 1, Chap V.)

Involuntary movements of the hand under the influence of the hypnotist's *mantras* (incantations) are also attributed to *adrista*.

SECTION 6.

MEASUREMENT OF MOTION. UNITS OF SPACE AND TIME.

The solar day was taken as a natural measure or division of time. In the Nyâya-Vaiśeșika School, the day of 24 hours (solar) is stated to contain $30 \times 30 \times 30 \times 18 \times 2 \times 2$ units of time (kșaņas). The Nyâya unit of time therefore measures 2/45ths of a second. The smallest measure of time mentioned by the astronomers is the Truti which is =1/33750th of a second.

The natural measure of length was the cubit (Hasta), of which there were two fixed standards (the greater and the lesser cubit). The smallest measure of length mentioned in the Silpa-sâstra (Technology) is the Paramâņu, which is about 1/349525th of an inch. This is the same as the Trasareņu of the Nyâya-Vaiśeșika School, which stands for the thickness of the minimum visible (the finest mote perceptible in the sunbeam, as it comes slanting into a dark room through a chink).

Average velocity (स्थूलगति —Bhâskara) was measured in accordance with the formula

$$v = \frac{s}{t}$$

but no unit of velocity appears to have been fixed upon. There was no idea of acceleration, and of course no measurement of force. Where the velocity is uniform, the interval of time may be of any amount (स्थूलकाल), but where the velocity is variable, (प्रतिक्षणसमागतिः—Bhaskara), an indefinitely small quantity of time (सूक्ष्मकाल) must be taken; in other words, the positions of the particle in two successive *instants* must be considered, and the velocity must be supposed to be uniform during this interval (conceived as indefinitely small, सूक्ष्म) It was in this way that Bhâskara determined the instantaneous motion of a planet (तत्कालिकी गति)

Component of velocity.

The astronomers measured the motion of a heavenly body in different directions (longitude, right ascension, etc.), and calculated separately the components of motion (गतिकलाः) in those directions.

And they adopted the device of transferring such component velocities from one body to another in the computation of relative motion (*e.g.*, एवं सति भ्याचार्येण लाघवार्थं स्पष्टदोःसम्बन्धिन्यो गतिकला भ्रके मदिताः Bhâskara, Siddhânta-Siromoņi, Gaņitâdhyâya, Ghatisphuti-prakaraņa).

SECTION 7.

NOTION OF THREE AXES.

Motion, we have seen, was defined as the change of position of a particle in space. To conceive position in space, Vâchaspati takes three axes, and the position in space of one particle relatively to another may be indicated by distances measured along these three axes (*vide* my paper on The Mechanical, Physical and Chemical Theories of the Hindus, in Dr. P. C. Ray's Hindu Chemistry, Vol. II, pp. 211-212). This remarkable analysis (circa 842 A.D.) वस्त्वङ्कवसुवत्सर Vâchaspati, Nyâyasuchinibandha) anticipates in a rudimentary manner the foundations of solid (co-ordinate) geometry, eight centuries before Descartes.

The principle of the differential calculus applied to the computation of motion (variable motion.)

Bhâskara (1150 A.D.) in computing what he calls the "instantaneous" motion (तात्कालिकी गति) of a planet compares its successive positions in two successive instants, and regards the motion as constant during the interval which he conceives to be indefinitely small (सूक्ष्मकाल). This is equivalent to the determination of the differential of the planet's longitude, and the process bears "a strong analogy" (to quote the words of Mr. Spottiswoode, the Astronomer Royal) "to the corresponding process in modern mathematical astronomy." I have elsewhere shown that Bhâskara's process was not merely analogous to, but virtually identical with, that of the Differential Calculus, Mr. Spottiswoode's cautious reservation having been due to his want of acquaintance with the original and the insufficiency of the materials placed before him. (*Vide* my paper on the Mechanical, Physical and Chemical Theories of the Hindus in Dr. P. C. Ray's Hindu Chemistry, Vol. II, pp. 158-163.)

SECTION 8.

RELATIVE MOTION.

The phenomenon is noticed among the hallucinations of sense) नाव्यारूढास्य गच्छतः पर्वतादीनि विजानन्ति धर्मेण भ्रमतश्च तान्—Kumârila, Sloka Vartika, p. 520). Astronomers like Âryabhata and Lalla who believed in the diurnal revolution of the Earth from the West to the East explained the apparent revolution of the starry Heavens in the opposite direction by the principle of relative motion.

SECTION 9.

SERIAL MOTION.

Several Santânas (series) of motions are incidentally noticed, *e.g.*, vibration (स्पन्दन, कम्पसन्तान), wave-motion (वीचितरङ्ग), current motion (स्यन्दन).

In an interesting passage, Charaka notes three instances of serial motion, *viz.*, those of water, sound and light (जलसन्तान, शब्दसन्तान and अर्चिःसन्तान) to which he compares the course (सन्तान) of chyle (or chyle blood) in the Dhamanîs (veins) and other ducts of the body.

Dalvana thinks that downward, oblique and upward currents of chyle are respectively intended by the three illustrations; but Chakrapâṇi points out that the Santâna (wave) of sound travels in all directions (the same is of course true also of light); and that differences in speed (and not in direction) are here meant. In other words, a Santâna of sound travels more rapidly than that of water and less rapidly than one of light (अर्चिःसन्तान), and Charaka's meaning is that the metabolic course may complete its circuit with greater or less speed. Whether, in this passage, the three Santânas are viewed as waves or currents is not specified. But the difference between a wave (वीचि) and a current (स्यन्दन) was well-known.

A current of water (स्यन्दन, downward flow) consists of particles moving in an uninterrupted series under the action of gravity and fluidity (गुरुत्व and द्रवत्व, Sankara Misra). A wave (वीचितरङ्ग), on the other hand, is constituted by the transmission of vibratory motion (स्पन्दन) in the water particles (*e.g.*, Jayanta, पतद्घनपयोबिन्दुसन्दोहस्पन्दनक्रमात् Nyâya-Manjari, Ahnika II).

A ray of light, on the other hand, was supposed to imply the rectilinear propagation of indefinitely minute corpuscles in all directions, with inconceivable velocity, and a sort of conical dispersion (अचिन्त्यो हि वेगातिशयः तेजः प्रसर्पति पृथग्रत्वात्-Udyotakára, Vâchaspati).

APPENDIX E.

HINDU IDEAS ON ACOUSTICS.

SECTION 1.

ANALYSIS OF SOUND.

The Mimâmsakas:—In their analysis of Sound, the Mimâusakas distinguish between three elements: (1) Nâda a quality of Vâyu (air), which is the physical basis of audible sound, (2) Dhvani, sound as heard, audible sound, and (3)—in the case of significant sound,—Sphota, 'transcendental' or 'intelligible' sound, representing the Platonic ideas or *logoi*, which are eternal (नित्य), ubiquitous (व्यापक), and noumenal (निराधार, lit., without substrate or ground—Kumârila). The Sphotas are manifested by the Dhvanis (audible sounds), of course only in the case of words (शब्द, संज्ञा). Upavarṣa, the teacher of Panini, rejects the *sphotas* in favour of the *varnas*, which are conceived to be "phonetic moulds" with natural significance.

As regards sound in its physical aspect and the mode of its propagation, some of the Mimânsakas content themselves with saying that Vâyu (air) has a special quality (Nâda), which causes audible sound, (नादो वायुगुणः वायुर्वा यदि कल्प्येत— Kumârila, Sloka-Vârtika). (वायुरेव ताल्वादिस्थानसंयोगात् शब्दगुणको निष्पद्यते, शब्दस्यापि वायुगुणत्वं वेदितव्यम्—Pârtha-Sârathi Misra, Nyâyaratnâkara). Others, including the teachers of the Sikshâ (Vedic chanting), hold that the physical basis of sound is a series of air movements (वायुसन्तान, cf. Udyotakára's and Vâchaspati's reports); in other words, the air particles themselves flow in a current in all directions, being obstructed in their path by the impact of tangible objects (*i.e.*, material bodies), and the movement ceases, as in the arrow, when the moving force is thus exhausted (*e.g.*, स गच्छन्नुपर्वतेतादिचु उद्दामवेगाहितक्रियः शरवत् वेगशान्त्यैव न दूरं गन्तुमर्हति...शिक्षाविदस्तु पवनात्मकमेव शब्दमाचक्षते, Jayanta Nyâya-Manjari). But the orthodox Mimânsâ view is that of the Mimânsâ Doctor, Savara Svâmi, who holds that Nâda (the physical basis of sound) is a wave motion of air, being the transmission of conjunctions and disjunctions in the minute particles of air, the wave originating in the first impact, and being continued by the successive impacts of the minute particles (*e.g.* संयोगविभागानैरन्तर्येण क्रियमाणाः शब्दमभिव्यञ्जन्तो नादशब्दवाच्याः (17-1-1) अभिघातेन हि प्रेरिता वायवः स्तिमितानि वाय्वन्तराणि प्रतिबाधमानाः सर्वतो दिक्कान् संयोगविभागान् उत्पादयन्ति यावद्वेगं अभिप्रतिष्ठन्ते । ते च वायोरप्रत्यक्षत्वात् संयोगविभागा नोपलभ्यन्ते । अनुपरतेषु एव तेषु शब्द उपलभ्यते । नोपरतेषु अतएव च अनुवातं दूरात् उपलभ्यते शब्दः—Savara Bhâshya, Sutra 13, Pada I, Adhyâya I). In this view, the particles of air (वाय्ववयवाः) are subject to a vibratory motion (a sort of *parispanda*) in the production of sound (परिस्पन्द विलक्षण—Jayanta, Nyâya-Manjari). The Vâkyapadiya describes articulate sounds (*varnas*) and indeed all sounds (*sabdas*) as only forms of air set in motion, with rarefaction and

condensation (प्रचय), and capable of variations of velocity and configuration (लब्धक्रियः प्रयत्नेन यत्तुरिच्छानुवर्त्तिना स्थाने ष्वभिहतो वायुः शब्दत्वं प्रतिपद्यते । तस्य कारणसामर्थ्यात् वेगप्रचयधर्म्मिणः संनिपातात् विभज्यन्ते सारवत्योऽपि मूर्त्तयः । Vâkya-padiya, Kânda 1, Sloka 109).

Nyâya-Vaiśeṣika :—The early Nyâya writers hold that the sound-wave (शब्दसन्तान) has its substrate in Akâsa (ether) and not Vâyu (air). Later writers (*e.g.*, Vâchaspati in the Tattvavindu) add that sound itself as a phenomenon is not to be conceived as a mode of motion (*parispanda*), for Akâsa, the substrate, is, in the Nyâya view, incapable of motion. (न तावत् परिस्पन्दस्तस्य मूर्त्यनुविधायिनो द्रव्ये विभुनि विभुगुणे वा शब्दे मूर्त्यभावेना संभवात्—Tattvavindu). At the same time, the propagation of sound must be conceived on the analogy of waves in water (वीचितरङ्गन्याय). Udyotakâra in the Vârtika, Vâchaspati in the Tâtparyyatîkâ, and Jayanta in the Nyâya-Manjarî controvert the three views current in the Mimânsâ school,—(1) that Nâda, the physical basis of audible sound, is a specific quality of Vâyu (air), (2) that sound in its physical aspect, is constituted by a series of air movements of the nature of a current (वायुसन्तान), and (3) that it is not air currents but air waves, series of conjunctions and disjunctions of the air particles or molecules (वाय्ववयवाः, वायुपरमाणवः), that constitute the Nâda, the sound physical, to which, in the case of significant sounds, the Mimânsakas assign the function of manifesting the *sphota*, 'transcendental' or 'intelligible' sound (logos, the word)—(*Vide* Udyotakâra Vârtika, Adhyâya 2, Ahnika 2, Sutra 14). Also Tâtparyyatîka, माभूत् वायुसन्तानो मा च भूततद्गुणो नादः शब्दस्य व्यञ्जकः वायवीयास्तु संयोगविभागव्यञ्जका भवन्ति इत्यतआह etc., loc. cit. Against these views, the early Nyâya Doctors maintain that sound is a specific quality of Akâsa (ether) and not of Vâyu (air). At the same time, they admit that the impact which originates the sound phenomenon (अव्याप्यवृत्ति अयावद्द्रव्यभावि विशेषगुण) in Akâsa does so by setting up a vibration in the molecules of the object struck (*e.g.*, a bell), and that these vibrating molecules impinge against the air molecules in contact (वायुपरमाणवः, आध्यात्मिकवायुः). In other words, though Akâsa is the substrate (आश्रय), the efficient cause of sound (निमित्तकारण) is to be found in the mechanical impact (अभिघात) of vibrating molecules of sonorous bodies against contiguous molecules of air. As to the propagation of sound, the early Nyâya-Vaiśeṣika writers content themselves with stating that the first sound thus produced in the substrate Akâsa by the impact of the vibrating molecules (*e.g.*, of a bell) against the contiguous molecules of air, produces a second sound in the contiguous Akâsa, and the second sound, a third, and so on, in the same way as waves are generated in water, until the last sound sets up a vibration in the ear-drum (कर्णशष्कुलि). Of course, this propagation of sound-wave in Akâsa (ether) is effected by means of the air-wave as its vehicle. This is the Nyâya-Vaiseshika hypothesis (कल्पना) of an independent sound-wave (शब्द-सन्तान). Akâsa (ether) is motionless, but the air-wave would not be transmitted, if the air molecules were not inter-connected by Akâsa. Praśastapâda, the Vaiseshika Doctor, for example, describes the first sound as giving off a second, the second a third, and so on, expanding in Akâsa, in the same way as waves are supposed to propagate themselves in the ocean शब्दोऽम्बरगुणः संयोगविभागशब्दजः............................ स्थानवायुसंयोगापेक्षमानात् स्थानाकाशसंयोगात् वर्णोत्पत्तिः । अवर्णलक्षणोऽपि भेरीदण्डसंयोगापेक्षा । भेर्य्याकाशसंयोगात् उत्पद्यते । वेणुपर्व्वविभागात् वेण्वाकाशविभागाच्च शब्दाच्च शब्दाच्च संयोगविभागनिष्पन्नात् वीचिसन्तानवत् शब्दसन्तान इत्येवं सन्तानेन श्रोत्रप्रदेशमागतस्य ग्रहणम् । Praśastapâda. यथा जलवीच्या तदव्यवहिते देशे वीच्यन्तरमुपजायते ततोऽप्यन्यत् ततोऽप्यन्यदित्यनेन क्रमेण वीचिसन्तानो भवति तथा क्रमेण शब्दसन्तानो भवति । नन्वेषा कल्पना कुतः सिद्धनतीत्याह etc., Sridhara, *ibid*). On this hypothesis, the locus of the sound at any moment forms a circle in Akâsa, and the propagation is carried on, in the air, by means of ever-expanding circles, as in the case of waves in water. But this analogy is rejected by some (*e.g.*, Udyotkâra), who hold that the first sound gives off, not one sound in a circle, but an indefinite number of sounds in all

directions, and each of these again gives off another, and so on, so that sound may be said to expand by successive concentric spherical layers, even as the Kadambakoraka (the so-called bud of the *nauclea kadamba*) expands by successive concentric spherical layers of filaments which shoot forth from one another. On the first of these two hypotheses, the air-wave implied in the transmission of sound is of the nature of what we call transverse waves; - on the second, of the nature apparently of longitudinal waves. In any case, it is clear that the orthodox Mimânsa view of Śavara Svâmi that the air-wave constituting physical sound means a series of mere conjunctions and disjunctions of air particles with rarefaction and condensation, सर्वतोदिक्कान्–संयोगविभागानैरन्तर्य्येण, (Śavara, प्रचय, Vâkyapadiya) implies longitudinal waves वीचितरङ्गन्यायेन तदुत्पत्तिस्तु कीर्त्तिता कदम्बकोरक न्यायादुत्पत्तिः कस्यचिन्मते Visvanâtha, Bhâshâ Parichheda, Sloka 165. परिशेषात्तु सन्तानसिद्धिः। तत्राद्यः शब्दः संयोग-विभाग-हेतुकः। तस्मात् शब्दान्तराणि कदम्बगोलकन्यायेन सर्वदिक्कानि । तेभ्यः प्रत्येकमेकैकः शब्दः मन्दतरतमादिभावेनाप्रवामप्रतिबन्धमनुविधीयमानः प्रादुरस्ति । ततोऽन्त्यस्यातिमान्द्यात् शब्दान्तरोत्पत्ति-शक्तिविघातो येन केनचित् प्रतिबन्धात् भवति (Udyotakâra, II, 2, 14). As the momentum of the impact series (which constitutes the efficient cause of the sound-wave) grows feebler and feebler in the course of transmission through the air particles, the sound at last dies away. Gangeśa in the Chintâmani holds that the propagation is not from molecule to molecule, but travels in ever-expanding circles as in water-waves, perhaps in spherical layers by compression of masses of air; and these air-waves, the vehicles of sound, are exceedingly swift. This explains the velocity of sound. (शब्देन च अव्यवहितपरमाणुदेशोत्पादक्रमेण न शब्दारम्भो येन मेघजादिशब्दानां भूलोक प्राप्तिर्युगान्तरेऽपि न स्यात् । किन्तु मेघाद्यभिहतं सर्वतोगामि-महावायोर्मद्धति देशे संयोग-निमित्तमासाद्य आद्यशब्देन सर्वे दिगन्तशब्दः एक एव जन्यते उत्तरोत्तरेणापि अधिकाधिकदेशतः सर्वत एकैक एव शब्दः वीचितरङ्गवदुपपद्यते वायोरच नयनवत् महावेगतया शीघ्रगामित्वेन अग्रिमशब्दारम्भात् आद्यशब्दानन्तरं अचिरेणैव शब्दोपलम्भः । वायोरेव च मन्दतरतमादिक्रमेण मन्दादिशब्दोत्पत्तिः यथा आद्य शब्देन कदम्बगोलकवद् दशदिशि दशशब्दा आरभ्यन्ते तैश्च दशशब्द सन्ताना इति (Gangeśa, Tattva Chintâmani).

But how does the first sound produce the second, the second the third, and so on? At every step, the efficient cause, the impact of some vibrating molecule against a contiguous molecule of air, must be posited, and this is equally applicable to a sound produced by a sound, (शब्दजशब्द) as to one produced by conjunction and disconjunction (संयोगज or विभागज). In other words, the sound-wave (शब्दसन्तान) in Akâsa necessarily implies an air-wave The Mimânsaka view, then, that explains the propagation of sound by the transmission of the original oscillatory motion through the successive layers of air by means of successive impacts or pressures producing conjunction and disjunction of air molecules (वायवीयाः संयोगविभागाः—Śavarabhâshya), or rarefaction and condensation (प्रचय—Vâkyapadiya), is also implied in the Nyâya-Vaiseshika doctrine of the sound-wave (शब्दसन्तान), the difference being that in the latter the air-wave, which is conceived as a mode of serial motion (गति-सन्तान) is only the vehicle or medium of propagation of a so-called sound-wave in Akâsa which is not itself a mode of motion. This is what we find expressly and elaborately formulated in the later Nyâya-vaiseshika (*vide* Gangeśa, Chintâmani, supra).

SECTION 2.

ANALYSIS OF VIBRATORY MOTION, E.G., OF A BELL (IN AIR).

The molecules of a bell vibrate when the bell is struck. The question is—what the nature of this vibratory movement? Vâtsyâyana and Udyotakâra answer that when the hand strikes the bell, some of the molecules are displaced (from their stable position,—*i.e.*, there is *karma* in the molecules), and thus a Sanskâra (here a kinetic Sanskâra, momentum) is generated (संस्कार, कम्पसन्तानसंस्कार, Vâtsyâyana and Vâchaspati), and the molecules swing forward under the action of this Sanskâra, until

they strike the contiguous molecules of air. This now is a case of mutual impact which divides the momentum between the colliding masses, and the bell-molecules begin to swing backward, the motion continuing under the action of the diminished Sanskâra, until they come in collision, again, with other air-molecules ;—and then the process is repeated, and the bell-molecules begin to swing forward and backward, until the original energy which is parted with in some measure at each impact becomes so feeble as to be unable to produce any kinetic disturbance (कर्म्म). Similarly, the air-molecules themselves are set vibrating by means of these impacts, and the transmission of the motion would form the wave of air, which the later Nyâya-Vaiseshika expressly posit as the vehicle of the sound-wave. But Udyotakâra never conceived vibration *in vacuo*, nor does it appear if he meant to include the second species of Sanskâra (elasticity, sthitisthâpaka sanskâra) as converted from its potential state (अतीन्द्रियत) into kinetic energy, and thus contributing to the momentum (*vega*). He uses the generic term Sanskâra, which comprehends elasticity as well as momentum due to impressed force. His commentator Vâchaspati does not go into details, and does not analyse the momentum. Later writers, however, expressly state that elasticity (sthitisthâpaka sanskâra) is one of the causes of vibration, and that elasticity resides not only in the element of earth, but also in air, water and *tejas* (cf. Visvanâtha).

घण्टायामभिहन्यमानायां तारस्तारतरो मन्दो मन्दतर इति श्रुतिभेदान्नानाशब्दसन्तानोहि अविच्छेदेन श्रूयते Vâtsyâyana, II, 2, 3.6 पाणिसंश्लेषमपेक्षमाणात् कर्म्मणः पाणि-घण्टा-संश्लेषात् पाणिगतवेगापेक्षात् घण्टायां कर्म्म तत्कर्म्म पाण्यभिघात-मपेक्षमाणं विभागसम-कालं संस्कारं करोति । सा चलन्त्याध्यात्मिकं वायुमुपगृह्णाति सा च वायुनाभिता पुनः कर्म्म करोति । ततः कर्म्मणः संस्कारः संस्कारेण पुनः कर्म्म पुनर्वायूपग्रह इत्येवमादिन्यायेन संस्कार उत्पद्यते । तत्र अन्त्यस्यातिमान्द्यात्घण्टायां महाभूतक्षोभशक्तेरभावः ततो वायूपग्रहो च्छेदः ततःसंस्कारक्षय इति (1) Udyotakâra Vârtika, Adhyâya 2, Ahnika 2, Sutra 36. (घण्टातदवयवसंयुक्ता वायुपरमाणव एव आध्यात्मिको वायुः Vâchaspati Tâtparyyatika, loc. cit. also संस्कारं वेगाख्यं करोति)—But cf. Visvanâtha संस्कारभेदो वेगोऽथ स्थितिस्थापकभावने । मूर्तमात्रे तु वेगः स्यात् कर्म्मजो वेगजः क्वचित् । स्थितिस्थापकसंस्कारः क्षितौ केचिच्चतुर्ष्वपि । अतीन्द्रियोऽसौविज्ञेय क्वचित् स्पन्देऽपि कारणम् Bhâshâ-pariccheda, Slokas 157-159.

As the air-wave forms the vehicle of the sound-wave, if it does not constitute the sound-wave itself, the favourable or retarding influence of currents of wind is easily explained. The presence or absence of water (and other intervening objects) offering greater or less resistance to the transmission of the wave-motion also easily accounts for the greater or less distance to which the sound is carried.

SECTION 3.

ECHO.

प्रतिध्वनि—Echo was supposed to be a reflection of sound. Some consider it to be an after-sound, a sound generated by sound. Others suppose it to be due to the reflection of sound in the same way as an image in water or in a mirror (प्रतिबिम्ब) is due to the reflection of light. There is an element of hallucination in either case (बुद्धिपरिणामविशेषः)—the image in water is not a real image, neither is the echo the real sound it is taken to be (रूपवत्त्वं च न सामान्यतः प्रतिबिम्बप्रयोजकं शब्दस्यापि प्रतिध्वनिरूपप्रतिबिम्बदर्शनात् । न च शब्दजन्यं शब्दान्तरमेव प्रतिध्वनिरिति वाच्यं स्फटिकलौहित्यादेरपि जपासन्निकर्षजन्यतापत्त्या प्रतिबिम्ब-मिथ्यात्वसिद्धान्तक्षतेरिति । प्रतिबिम्बश्च बुद्धेरेव परिणामविशेषो बिम्बाकारो जलादिगत इति मन्तव्यम् । Vijnânabhikṣu, Pravachana-Bhâṣya, Chap. I, Sutra 87.)

SECTION 4.

PITCH, INTENSITY AND TIMBRE.

Sounds differ from one another by their pitch (तारमन्दादिभेद), by their intensity (तीव्रमन्दादिभेद), and by their quality or timbre(असाधारण धर्म्म.) When a bell is struck, an indefinite number of notes (श्रुतिभेद, tones and overtones) are emitted, of varying pitches ; and the notes die away, becoming less and less intense. Now we know that the molecules swing to and fro, and that the Sanskâra (momentum, vega) of the vibrations (कम्पसन्तानसंस्कार) grows feebler and feebler. The differences in pitch (tones and overtones) as well as in intensity must be due to variations in the Sanskâras of the vibrations. The distinguishable pitches (called Srutis, श्रुतिभेद) as well as the degrees of intensity (तीव्रमन्दादि) must be ascribed to variations in the *vega* (momentum), and, by implication, the frequency, etc., of the vibrations.

Cf. Vâtsyâyana, II, 2, 36—घण्टास्थं सन्तानवृत्तिसंस्कारभूतं पटुमन्दमिति वर्त्तते तस्यानुवृत्त्या शब्दसन्तानानुवृत्तिः पटुमन्दभावाच्च तीव्रमन्दता शब्दस्य तत्कृतश्च श्रुतिभेदः *Vide* also Udyotakâra's analysis of vibration based on Vâtsyâyana— घण्टायामभिहन्यमानायां तारस्तारतरो मन्दोमन्दतर इति श्रुतिभेदान्नानाशब्दसन्तानो हि अविच्छेदेन श्रूयते । सन्तानवृत्तित्वात् मन्दतरमन्दतमादिभिन्नरूपानुविधायिनं शब्दमुत्पादयन्ति तच्च कारणं संस्कारः— Udyotakâra, Vârtika, Adhyâya 2, Ahnika 2, Sutra 36 – सन्तानवृत्तिना कारणेन श्रुतिभेदोत्पत्तिः Vâchaspati, Tâtparyyatîkâ, loc. cit.)

Sounds also differ from one another in volume or massiveness in the case of coalescence (समानजातीयोपचय). A sound both loud and massive is called महान् (large)—स्वं शब्दसन्तान एव तारः महान् इत्युच्यते तत्राप्यस्ति समानजातीयोपचयः अस्ति च स्फुटतरत्वम् महानपि स्फुटतरः । अयमपि तथा इति महानित्युच्यते Vâchaspati, II, 2, 36.

Śavara, the Mimânsâ Doctor, explains massiveness (महत्त्व) as due to नादवृद्धि the coalescence of different air-waves, which by their simultaneous impact affect a comparatively large tract of the ear-drum (यच्चैतत् बहुभिर्भेरीमाध्मानाद्भिः शब्दमुच्चारयद्भिर्महान् शब्द उपलभ्यते । न वर्द्धते शब्दः । मृदुरेकेन बहुभिरुच्चार्यमाणे तान्येव अक्षराणि कर्णशष्कुलीमण्डलस्य सर्वां नेमिं व्याप्नुवद्भिः संयोगविभागनैरन्तर्य्येण अनेकशो ग्रहणात् महान् इव अवयववानिव उपलभ्यते । संयोग विभागानैरन्तर्य्येण क्रियमाणाः शब्दमभिव्यञ्जन्तो नादशब्दवाच्याः । तेन नादस्यैषा वृद्धिः न शब्दस्य—Śavara on Jaimini, Sutra 17, Adhyâya 1, Pâda 1). The Mimânsakas who resolve sounds into air waves attribute all differences, whether of pitch, intensity, or massiveness, to differences in the series of conjunctions and disjunctions of air particles that form the waves (*Vide* Vâchaspati's report शब्दानां तु संयोगविभागयोनीनां युक्तस्तद्भेदेन रूपभेदः) Cf. also the later Nyâya-Vaiseshika which accepts air-waves as vehicles of sound-waves :—वायोरेव मन्दतरतमादिक्रमेण मन्दादिशब्दोत्पत्तिः (Gangeśa, Tattva Chintâmani). It may be noted that the terms तीव्र and मन्द are occasionally used in a general sense, and applied to express higher and lower degrees of pitch as well as of intensity.

There are also differences of quality (शब्दस्य असाधारणधर्म्मः) The same sound *ga* (ग), of the same pitch and intensity, uttered by men, and parrots, can be distinguished—so also the sounds, even the same notes of the scale, given out by a wind instrument like the *venu*, and a stringed instrument like the *vina*. Similarly, there are sexual and even individual differences of voice (अस्ति हि शुकसारिकामनुष्यवक्तप्रभवेषु कारादिषु स्फुटतरः रूपभेदप्रत्ययः पुंसाम् । एवं स्त्रीपुंसप्रभवेषु स्त्रीपुंसभेदप्रभवेषु च— Vâchaspati, Tâtparyyatîkâ, II, 2, 14,—वीणा वाद्यते वेणुः पूर्य्यते वीणावेणुशब्दयोरसाधारणो धर्म्मः—Udyotakâra, II, 1, 15—वेणुवीणामृदङ्गादिप्रभवेषु भेदप्रत्ययः शुकसारिकामनुष्यकण्ठोत्थादिभेदप्रत्ययः—Gangeśa and Mathurânâtha). The sounds emitted by impact of the different Bhutas (echo from Akâśa, hissing from the wind, puffing from fire, bubbling from water, and

splitting or cracking from earth) are characteristic examples of such differences of timbre (*Vide* Panchadaśi, Bhutaviveka, Sloka 3).

The Vâkya-padiya (Kânda I, Sloka 100), as we have seen, ascribes all differences (whether of pitch, volume or timbre) to the characteristic forms of the air waves, which differ from one another by their configuration (सन्निपातात् विभज्यन्ते मूर्त्तय:), and are capable of variations of velocity (momentum, vega) as well as of rarefaction and condensation (कारणसामर्थ्यात्) प्रचयधर्म्मिण:

There are passing references to the obscuration (अभिभव) of sounds in Vâtsâyana, Udyotakâra and Vâchaspati, but the subject is treated more from a psychological than from a physical point of view (तीव्रभेरीशब्द: मन्द तन्त्री-शब्दमभिभवति न मन्द: । नानाभूतेषु शब्दसन्तानेषु सत्सु श्रोत्र-प्रत्यासत्तिभावेन कस्यचित् शब्दस्य तीव्रेण मन्दस्य अभिभवो युक्त: (Vâtsâyana, II, 2, 14, *vide* Udyotakâra and Vâchaspati, loc. cit. Here तीव्र = loud, and मन्द = low.)

SECTION 5.

MUSICAL SOUNDS.

Srutis and Svaras :—We have already seen that the distinguishable pitches are called Srutis, and they are proportioned to the vega (momentum) of the kampa-santana (vibration). Now the ratio of a note to its octave (in respect of pitch) is given as 1 : 2,—we may therefore conclude that the *vega* of the vibration in the latter case was considered to be twice as great as in the former. An indefinite number of Srutis could be interposed between a note and its octave (आनन्त्यं हि श्रुतीनां च सूचयन्ति विपश्चित: यथा ध्वनि विशेषाणामानं गगनोदरे । संगीतरत्नाकर । Cf. संगीतपारिजात । केशाग्रव्यवधानेन बह्व्योऽपि श्रुतय: स्मृता:—संगीतपारिजात, Sloka 40), Twenty-two such are named and recognised for musical purposes. But a Sruti as such cannot constitute a musical tone (svara). A sruti is a simple (unmixed) and fundamental tone of a certain pitch, whereas an ordinary musical tone (svara) is really composed of a fundamental tone (sruti) and certain partial tones, (harmonics, Anurananas, (अनुरणन) The musical tones (svaras), vocal or instrumental, are therefore of the nature of what we call clangs, because, either accompanying or following the Srutis or simple fundamental tones (हृस्वादिमात्र) are always found certain partial tones (अनुरणन) व्यवहारे त्वसौ त्रेधा हृदि मन्द्रोऽभिधीयते । कण्ठमध्यो मूर्ध्नि तारो द्विगुणश्चोत्तरोत्तर: (संगीतरत्नाकर) हृदिमन्द्रोगलेमध्यो मूर्ध्नितार इति क्रमात् । द्विगुणः पूर्व्वपूर्व्वस्मात्—Dâmodara, Sangitadarpaṇa, Chap. I, Sloka 40. श्रुत्यनन्तरभावी य: स्निग्धोऽनुरणनात्मक: । स स्वर: उच्यते—Sangita-ratnâkara—स स्वरोय: श्रुतिस्थाने स्वनन् हृदयरञ्जक: (संगीतदामोदर) द्वाविंशतिविधो मन्द्रोध्वनि: सञ्जायते हृदि । स एव द्विगुणो मध्य: कण्ठस्थाने यथाक्रमम् । स एव मस्तके तार:स्यान्मध्यात् द्विगुणक्रमात्—Sangita Samaya Sâra, 1, नादाश्च श्रुतयो जातास्तत: षड्जादय: स्वरा: । प्रथम श्रवणाच्छब्द: श्रूयते ह्रस्वमात्रक: सा श्रुति: सम्परिज्ञेया स्वरावयव लक्षणा: । स्वरूपमात्रश्रवणान्नादोऽनुरणनं विना । श्रुतिरित्युच्यते Dâmodara, Sangitadarpaṇa, Chap. I, Sloka 51. The relation between a Sruti and a Svara is variously conceived as (1) परिणाम model change; (2) व्यञ्जन manifestation; (3) तादात्म्यम् जातिव्यक्त्योरिव the relation of genus and species; (4) विवर्त्तन (मुखं यद्वद् दर्पणेषु विवर्त्तितं) reflection; (5) कार्य्यकारणभाव, the relation of cause and effect; Cf. संगीत पारिजात by Ahobala, श्रुतयस्तु स्वरा भिन्ना: श्रावणत्वेन हेतुना । अहिकुण्डलवत् तत्र भेदोक्ति: शास्त्रसम्मता । संगीतपारिजात Sloka 38.

SECTION 6.

THE NOTES OF THE DIATONIC SCALE: DETERMINATION OF THEIR RELATIVE PITCH.

The pitch of a note is inversely proportional to the length of the wire (तन्त्री तन्तुस्वरो ज्ञेय: तद्दैर्घ्यव्यस्तमानत:) (शेषलीलावती quoted by Mr. Devala in his 'Hindu Musical Scale').

The pitch of the fundamental note to that of its octave is as 1 : 2 (मध्यस्थानस्थ: षड्ज: द्विगुणं सम :—रागविबोध quoted by Mr. Devala).

The pitch of the fourth note (F) to that of the fundamental (C) is as 4 : 3 (उभयो: षड्जयोर्मध्ये मध्यमं स्वरमाचरेत्-संगीतपारिजात quoted by Mr. Devala).

The virbrations of the fifth note (G) to those of the fundamental (C) are as 3 : 2 (त्रिभागात्मकवीणायां पञ्चम: स्यात्तदग्रिमे । (संगीतपारिजात quoted by Mr. Devala).

Concord (सम्वादित्व) is either perfect or imperfect. The ratio of perfect concord is 3 : 2—that of imperfect concord, 4 : 3—स-प-स-म मुख्या: संवादिन: स्वरा: एकसंश्रया: प्राय: (रागविबोध quoted by Mr. Devala) *e.g.*, if D be the Vâdi, A would be a Samvâdi, if E be the Vâdi, B would be a Samvâdi, in each case a perfect concord. The pitch of D is determined from that of G, and the pitch of A from that of D, in each case by the rule of perfect concord.

Determination of the pitches of E and B :—(after Mr. Devala). This may be done in either of the following ways :—

(1) E may be determined from A, and B from E by the rule of perfect concord. This would give $303\frac{3}{4}$ as the value of the pitch of E, and $455\frac{5}{8}$ as that of the pitch of B, if the pitch of C be taken as 240 ; *or*

(2) E may be determined from C by reduction of the fifth harmonic by two octaves, a sort of imperfect concord; and then B may be determined from E by the rule of perfect concord. This would give 300 for E, and 450 for B, if C be taken as 240.

Mr. Devala in his investigations with the "Sonochord" finds that Hindu musicians (and Sanskrit writers on music) adopted the latter values for E and B, as they tested their notes by harmonics (नैसगतस्त्रयम्भूस्वरप्रक्तिप्रामाण्येन—रागविबोध quoted by Mr. Devala). The Hindus therefore followed just intonation.

SECTION 7.

MUSICAL INTERVALS.

Musical tones are related to one another in four ways as Vâdis, Samvâdis, Vivâdis and Anuvâdis. The mediæval compilations explain these in reference to melody, and harmony is altogether unknown, but the terms might be used to indicate relations of harmony as well. The Vâdi might in that case answer to the key-note (or tonic); and the Samvâdis to the two consonances, the fifth (2 : 3), and the fourth (3 : 4).

The rule given for the determination of a Samvâdi is 12 or 8 Srutis intervening, the intervals being therefore 13 and 9 Srutis respectively (giving the ratios [illegible] and [illegible]).

C being the Vâdi, G and F are stated to be the Samvâdis. The first would answer to the dominant, and the second to the sub-dominant.

In the same way, it is stated that if D be the Vâdi, A would be a Samvâdi. If E be the Vâdi, B is given as a Samvâdi.

On the other hand, a two-Sruti interval (*i.e.*, a difference of a semi-tone) gives a Vivâdi, which would thus answer to a dissonance. This is given as a general rule (द्विश्रुत्यन्तरौस्वरौविवादिनौ mâtanga). Other cases are also noticed; *e.g.* E is a Vivâdi to D, and B to A, and *vice versâ* (ratio of 9 : 10).

The notes that do not come under these heads are Anuvâdis (*e.g.*, the sixth), cf. Bharata, Nâtya-Sâstra, Chap. 28, Slokas 23-24.

Also Sangita-ratnâkara :—

चतुर्विधा स्वरा वादी सम्वादी विवाद्यपि अनुवादीति । वादीतु प्रयोगे बहुलस्वरः श्रुतयो द्वादशाष्टौ वा ययोरन्तरगोचराः मिथः सम्वादिनौ तौ स्तो निगावन्यविवादिनौ । रिधयोरेव वा स्यातां तौ तयोर्वारिधापपि । शेषाणामनुवादित्वम् । (स्वराध्याय)